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REFINER AND NATURAL GASOLINE MANUFACTURER

OCTOBER, 1941
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GRADY TRIPLETT
Editor

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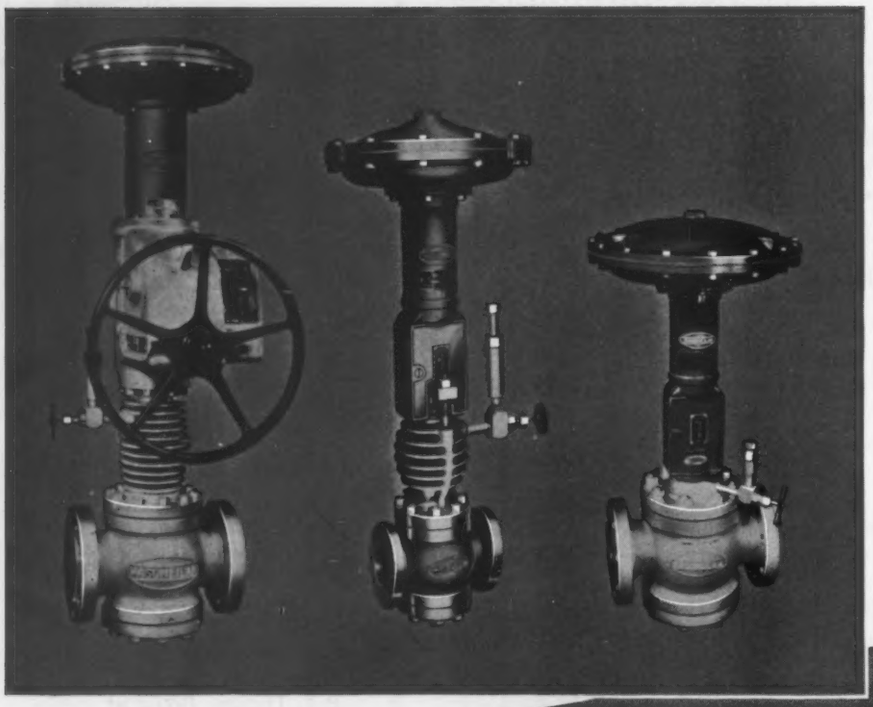

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VOLUME 20, No. 10 OCTOBER, 1941

REFINER
AND NATURAL GASOLINE MANUFACTURER

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The Look Box

EXAMINATION of storage totals for the Atlantic Seaboard leaves the conviction that the Senate Committee was correct in branding the situation as a "shortage of surplus" rather than deficiencies to justify curtailment in use. The Atlantic Coast situation is treated extensively by L. J. Logan under the title "Favorable Results Achieved in Supplying East Coast" on another page of this issue.

Figures Reveal No Serious Shortage

Briefly it is this: crude oil in storage is about equal to the total for this season last year and almost 2,000,000 barrels higher than in 1939; gasoline is only 1,000,000 barrels below 1940, when the supply was so excessive that it drove the price to the lowest levels in the history of the industry; furnace oil stands at the same total of 1940, when the supply was considered adequate for the winter, and 5,000,000 barrels higher than two years ago; heavy fuel oil is well below the 1940 total, 2,500,000 barrels, and equal to 1939; kerosene is about normal; lubricants 15 percent below 1940.

This has been accomplished despite the diversion of about 80 tankers from coastwise to trans-Atlantic service. It is convincing evidence of the ability of the industry to adjust itself to other means of transportation and better use of tankers left in service. Furthermore, the full effect of the extension of oil shipments is yet to be reached. Likewise pipe-line deliveries will move to still higher daily totals.

The shortage in heavy fuel is serious, as stocks are down 20 percent while consumption is up 20 percent. Fortunately half the consumption of heavy fuel can be withstood by adoption of other heating means, especially coal. Many industrial plants, among them refineries, already have adjusted furnaces to burning coal.

One of the serious shortages is lubricants, about which little has been said in the office of the petroleum coordinator. This product has no substitute. Increased output of Pennsylvania oils is being discouraged by price ceilings, despite the apparent need for maintaining adequate lubricants in Atlantic Seaboard storage.

THE many brash statements that have come out of the petroleum industry to the effect that it is prepared to meet any demand of military and civilian consumption of its products have been unwise, unnecessary and without basis of substantiation. By such the industry has promised to fulfill an unknown need. No sales manager would promise to supply the wants of a customer until the amount of merchandise had been determined. But the industry has through the statements of several of its top-ranking executives promised to deliver an undetermined quantity of merchandise.

Why Promise to Fill Unknown Consumption

Chiefly the mounting consumption of petroleum products lies in military demands. Thus far neither the Army nor the Navy has made known what amounts of high-octane gasoline and fuel oil it will require for a year in advance. Perhaps no agency of the military can calculate its needs over such a period. Perhaps no commission can calculate what England will require or what Russia needs.

Why the requirements cannot be calculated is not the fault of the industry.

The industry is at fault when it promises to meet what its customer can not or will not determine.

What the industry has done is of consequence. Diversion of tankers for convoy service was a serious blow, one the industry did not anticipate. Despite it the industry has done a creditable job of keeping supplies in proper concentration. This came from action rather than talk. It should continue to do things and talk less, except about its accomplishments.

Confusion in the Control Room

NO ONE doubts the ability of the petroleum industry to build 50 new refining plants. But there is doubt as to the ability of the industry to build them in time for any service to nations fighting the Axis if the industry must work with less steel than in previous years.

Abnormal refining construction with reduced steel available does not make sense.

Thus far the Petroleum Coordinator has not given details. The 50 new refining plants, plus additional capacity for making 100-octane gasoline, remain simply a statement to the effect that additional capacity is to be built. Size of the plants was not mentioned. The amount involved was given as $150,000,000, which will not build 50 plants of 10,000-barrels capacity each.

The call for more refining capacity September 25 was another of the confusing statements that have come from the office of the coordinator. Only a week earlier both Ralph K. Davies, assistant coordinator, and Wright Gary, a member of the staff, were telling the industry that less steel would be available for refinery construction and Gary urged rehabilitation and alteration of existing capacity rather than new construction.

When Harold L. Ickes was named coordinator he was charged with "making petroleum and petroleum products available, adequately and continuously in proper forms, at the proper places and at reasonable prices to meet military and civilian needs."

The full letter of the President gave the impression that the coordinator was to lend his efforts to simplifying and clarifying the relationship between the government and the industry to the end that the national-defense program would not be hampered.

Since then, however, the statements and the actions of the coordinator and his staff have brought confusion rather than clarity.

The first move was to take steps to deal with a shortage of gasoline on the Atlantic Seaboard. But a Senate Committee investigated that situation and came to the conclusion that the only shortage evident was one wherein the amount of gasoline in storage was not up to expectations.

Next came the effort to have a gigantic pipe line built from Texas to the Atlantic Seaboard. After much time had been spent and much effort put forth, another agency of government came to the conclusion that steel was not available for the line. It would seem that a few telephone conversations could have answered the pipe-line issue before the area survey was made.

It would be enlightening to the industry and doubtless to the government if one of its agencies would give a total in barrels for the requirement for national defense. Then the industry would know how much refining capacity to add, how to use what it has.

So far no agency of government has even estimated requirements in barrels. If the Army and the Navy know how much gasoline they will need in 1942, they have not told the industry. If anyone knows how much England and Russia will need, the figures have not been made public.

The petroleum coordinator has charged the industry with providing for "any foreseeable demand." That is an indefinite order. Only recently he called for doubling the output of 100-octane gasoline. Now along with the call for 50 new refining plants and "an unspecified number of by-product plants," he speaks of trebling the output of this product. The whole program is classed as one involving expenditure of $150,000,000.

Size of the plants was not mentioned. If they average 10,000 barrels daily capacity, which is only a small plant, the cost will reach $400,000,000 rather than $150,000,000. There will be an additional and unpredictable amount necessary for the "unspecified" by-product plants.

If the plants are smaller than 10,000 barrels each, by which the total can be kept within $150,000,000, the amount of cracking-still gases in each will not be sufficient to justify installation equipment for the selective processes by which blending ingredients can be made.

A program of 50 new plants of 10,000 barrels capacity each with additional units for polymerization, alkylation and iso-octane will more than treble the supply of 100-octane gasoline. Besides that, the present refining capacity has by no means reached its limit of working with gases and special cuts from natural gasoline for the making of blends for this desirable aviation fuel.

How all of this can be done without using more steel than the industry used last year and the year previous evidently has not been contemplated. Unless there are some unannounced refining processes ready to come out of the laboratories, the accomplishment can be reached only by magic.

Action of Sulphur Upon Hydrocarbons Under High Pressure

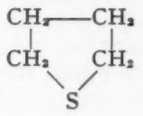
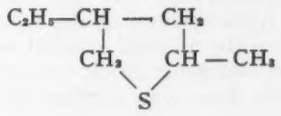
WALTER FRIEDMANN
Laboratorio De Investigacion De La Gerencia De Refinerias
Petroleos Mexicanos

THE outlined program for investigation of the sulphur compounds occurring in the Mexican crude oils indicates the advisability of setting up certain experiments for the purpose of synthesizing possibly one or more groups of these compounds that occur in these oils. The ultimate results will answer the question as to what benefits might be obtained from this method of "analysis through synthesis." The publication of the results of the study of certain reactions between hydrocarbons and sulphur under pressure is thought valuable because of the widespread interest displayed in this field. The reference material, as far as the organic sulphur compounds are concerned, is so limited that any addition of a new item is highly desirable. Due to limitations of space this article is confined to the most important features, omitting the less important or less successful points of the experimentation.

In order to study step by step the progress of different reactions, higher temperatures, longer contact time and excess of sulphur have been definitely eliminated from the experiments—a procedure which has fully confirmed the correctness of our original outline. In case an insufficient amount of sulphur is used in a certain reaction, the yield of the reaction product will be decreased; on the other hand, an excess of hydrocarbon might act as a diluent and retard the progress of the reaction, thus allowing investigation of the intermediate stages of the reaction. Many interesting conclusions could be drawn if only such intermediate products could be isolated and then treated with an additional amount of sulphur.

From the results of experiments conducted on normal heptane, $CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$, isooctane, $CH_3-C(CH_3)_2-CH_2-CH(CH_3)-CH_3$, and isodecane, $CH_3-CH(CH_3)-CH_2-CH_2-CH_2-CH_2-CH(CH_3)-CH_3$, in addition to those results obtained by the author when experimenting with normal octane, $CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$, (1) the following general conclusions are arrived at:

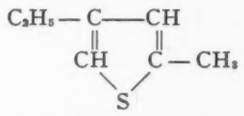
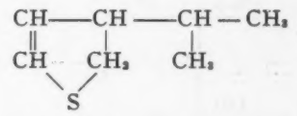
(1) The normal hydrocarbons change into branched systems, especially those which, under the directional influence of sulphur, tend to form a five-membered ring with sulphur in the bridge. The latter, obtained during a mild reaction, are generally regarded as thiophanes,

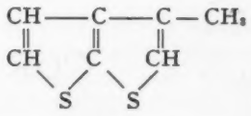
(2) The branched hydrocarbons give simultaneously thiophanes and sulfides, CH_3-S-CH_3, which are formed when, for example, the quaternary carbon atom of the branched hydrocarbons (isooctane) cause a slight disintegration of the molecule, after which the fragments of the branched molecule react with sulphur.

(3) Thiophanes react further with sulphur forming:

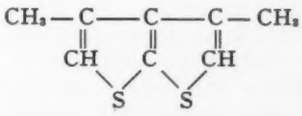
(a) Thiophenes with partially dehydrogenated products as intermediate compounds; from normal paraffines:

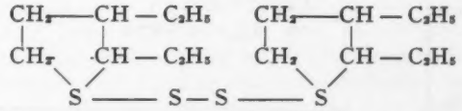
(b) Thiophthenes (probably thiophthanes, too); from normal heptane:



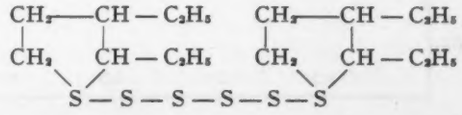
and from normal octane:



(c) Polythiophanes or thiophane polysulfides; from isooctane:

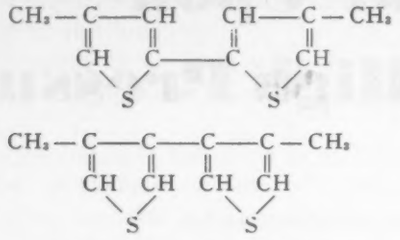


and



(d) Dithienyls (probably hydrogenated dithienyls

as an intermediate product); from isodecane:



and

(I). Normal Heptane

One hundred g. normal heptane, $d_{20°} = 0.6836$, was treated with only 15 g. sulphur for the reasons explained before. The mixture was heated to 275-285° C. for 18-20 hours in a steel autoclave with agitation. During the reaction the pressure reached 40 atmospheres. The gases generated, composed mostly of hydrogen sulphide, were not analyzed at the time. In spite of mild conditions 15 percent by volume of the charging stock remained as carbonized material. This loss was further increased by one distillation loss amounting to 5 percent by volume of the reaction product.

Reaction products obtained from four experiments had the following specific gravities:

Experiment No.	I	II	III	IV
$d_{20°}$	0.713	0.708	0.710	0.705

Curve No. 1 shows the progress of the distillation of the reaction product. After the recovery of the unreacted portion of normal heptane the distillation was continued until the distillate showed about $d_{20°} = 0.92$, in other words, until most of the thiophene fraction was driven off. The corresponding residua had the following specific gravities:

Experiment No.	I	II	III	IV
$d_{20°}$	0.949	1.010	1.058	0.956

Curve No. 2 shows the progress of the distillation of one of these residua. The curve rises sharply about 180° C. in Fraction 5, then a plateau is formed between 220-225° C. in Fraction 6 which, as will be shown later, corresponds to methylthiophthene. Finally there is a steep rise noticeable in Fraction 7.

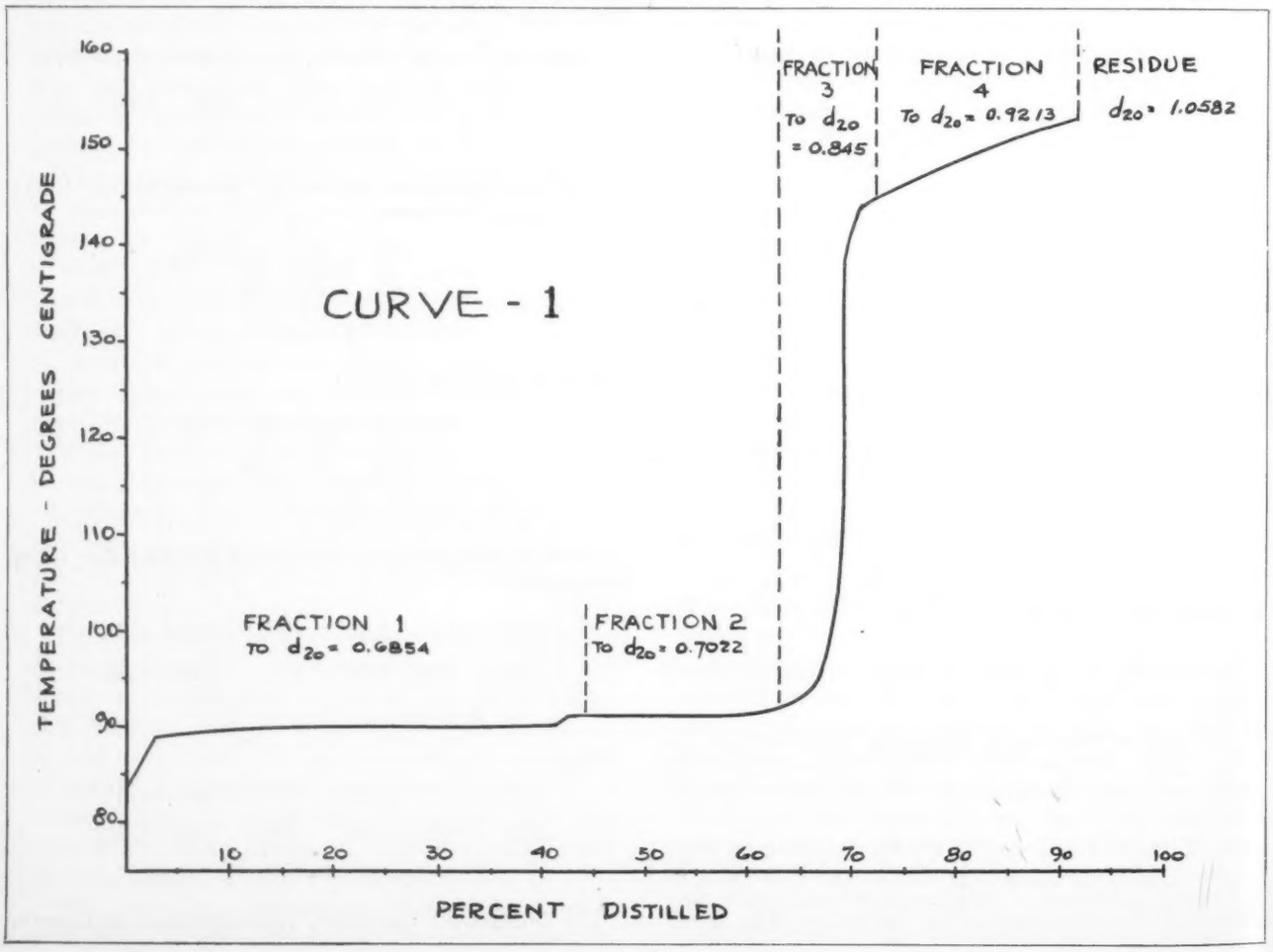
Thiophene Fraction, Boiling 145-153° C. at 590 mm.

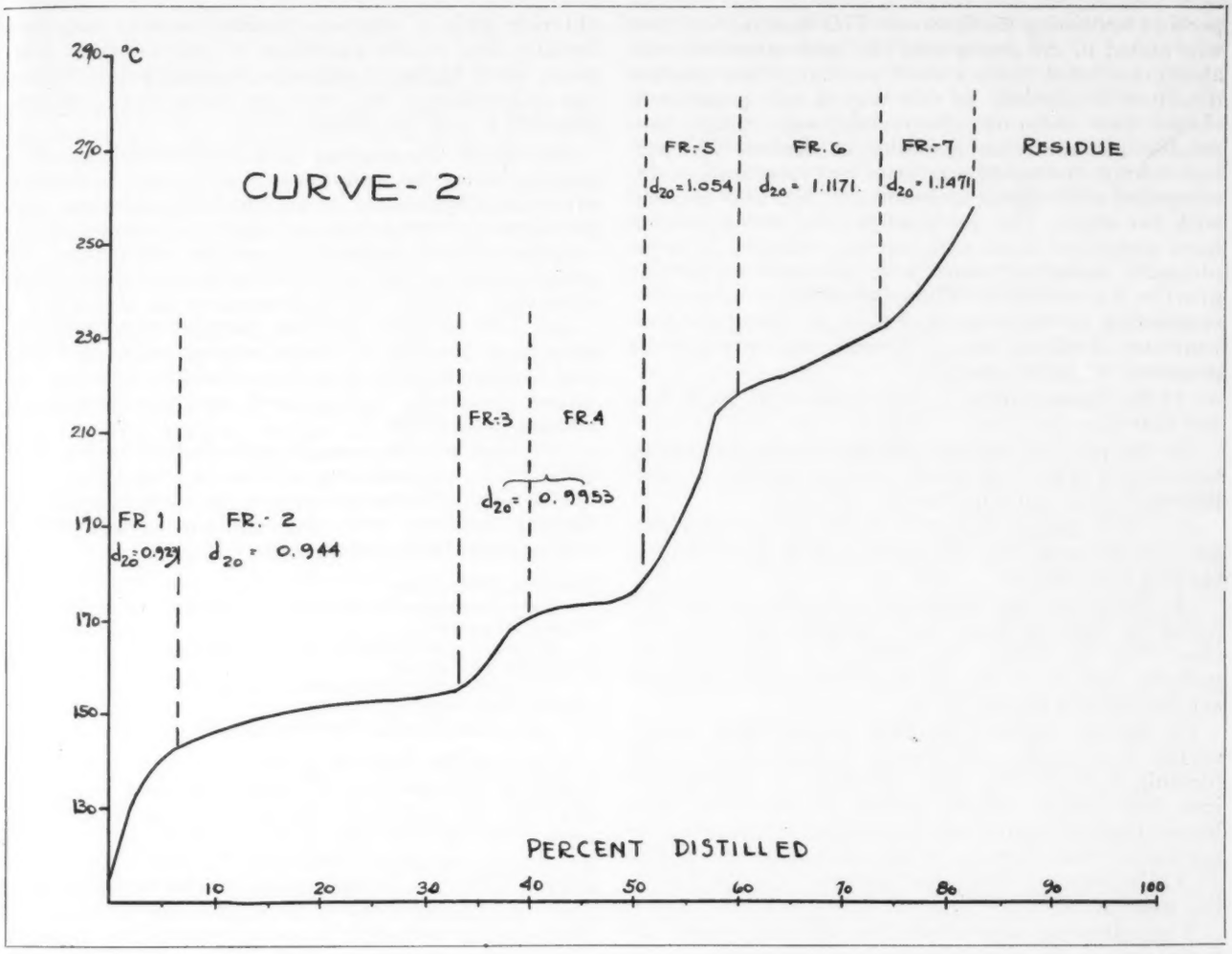
It should be pointed out that the Fraction 4, Curve No. 1, shows almost the same specific gravity, $d_{20°} = 0.9213$, as was published by Baker and Emmet Reid[2] for the thiophene, $C_7H_{10}S$, that they obtained by treating normal heptane with sulfur, $d_{20°} = 0.9221$.

H. Scheibler, who distilled off a high sulphur oil called ichthyol, from fossilized fish remains, succeeded in obtaining a fraction boiling 170-180° C. at 760 mm. with a composition corresponding to the formula $C_7H_{10}S$, which, he suggested, might represent propyl-, isopropyl-, methylethyl- or finally trimethylthiophene.[3]

F. Challenger and co-workers, when investigating the sulphur compounds from the Kimmeridge shale oil, also isolated a fraction boiling at 158-162° C. at 760 mm. and having a formula $C_7H_{10}S$, but failed to explain which one of the above named homologues of thiophene was present in this natural product.[4]

After a number of redistillations of the Fraction 4, Curve No. 1, and of the Fractions 1 and 2, Curve No. 2, the distillates which showed the same specific





gravity were blended and redistilled. In spite of using an efficient fractionating column it was not possible to obtain an overhead product, boiling within a narrow range of temperatures. This overhead product, boiling within 8-10° C. range, did not increase in specific gravity above $d_{20°} = 0.9280$. Consequently the overhead product represented a mixture which could not be separated by further redistillations.

On the assumption that thiophanes are formed first during the action of sulphur upon hydrocarbons, then gradually transformed into partly dehydrogenated products during the prolonged action of hydrogen splitting media, e.g., sulphur or selenium, and finally into thiophenes, it was necessary to ascertain whether the above fraction could undergo any other change if treated with additional portions of sulphur. (The foregoing reaction will be discussed later on.) For this reason Fraction 2, boiling at 145-153° C., was heated with powdered selenium under reflux. A similar experiment was also carried out in a sealed glass tube. This last method led to a uniform product after 6 hours heating at 220° C., but due to the loss of one tube charge the experiment had to be limited to the method of heating under reflux.

While the experiment was proceeding it was noticed that, in spite of a low temperature (155° C.), hydrogen selenide was splitting off; after a period of 36 hours a marked progress in the dehydrogenation could be noticed by increase in the specific gravity and finally, after an additional 36 hours, the specific gravity rose to $d_{20°} = 0.9510$. After the redistillation of the reaction products, separated from selenium by filtration, the overhead product showed the following constants: b.p. 148-151° C. at 588 mm., $d_{20°} = 0.9510$ and $n_D^{20°} = 1.5036$.

This fraction gave the color reaction typical of thiophene, i.e., it reacted with isatine giving a brilliant cardinal-red color and with phenanthraquinone a violet ring. This fraction, as will be shown in the text later on, was used in a series of experiments. In the first instance it was necessary to obtain a uniform product, free from any impurities and for this reason it was necessary to investigate the product resulting from the decomposition of a mercuric chloride compound. A 33 percent by volume sodium acetate solution and a saturated aqueous solution of mercuric chloride were added to the alcoholic solution of the dehydrogenated fraction, b.p. 148-151° C., and the mixture was shaken vigorously. The white mercury compounds (A), which separated after 12 hours standing, were filtered out and investigated separately. Later on the yellow, putty-like and somewhat oily precipitate (B) was collected and kept separately from (A). The mercury compounds (A) were washed on the filter with petroleum ether and were completely dried on the porous clay dish, whereas the compounds (B), in spite of repeated washing with petroleum ether, had to be worked on the porous clay dish for a longer time until the product became dry to a certain degree.

The white mercury compounds (A) were dissolved in a mixture of acetone and benzol (1:1) with a small

portion remaining undissolved. This undissolved part was added to the precipitate (B) and extracted with absolute alcohol. Only a small portion of this mixture dissolved in alcohol. In this way it was possible to obtain two separate compounds, one which was soluble, and the other insoluble in alcohol. The portion soluble in alcohol was, after recrystallization, decomposed with dilute hydrochloric acid and distilled with live steam. The overhead product was separated from water and dried with calcium chloride. It had a pleasant aromatic odor and showed a specific gravity, $d_{20°} = 0.9525$. The analysis gave values corresponding to the formula of $C_7H_{10}S$. Using the conventional methods the following derivatives were prepared from this material:

(1) By bromination, a dibromide $C_7H_8Br_2S$, b.p. 228-232° C.;

(2) By reacting with hydroxylaminehydrochloride, an oxime, a heavy yellow oil which would not crystallize even after standing for several weeks;

(3) With acetylchloride (+ aluminum chloride), an acetothienone, b.p. 225-230° C., with an odor typical of a fruit ether;

(4) From the last compound a hydrazone was prepared by boiling same with paranitrophenylhydrazine. This hydrazone crystallized in brownish red globules and after two recrystallizations from ethyl acetate melted at 166-167° C.

(5) By the action of mercuric chloride and sodium acetate a crystalline compound corresponding to the formula $C_7H_9S\text{-}ClHg$ was obtained. It crystallized into fine silvery leaflets which on the filter were bound together into a silvery coating. After seven recrystallizations from a benzol and acetone mixture (1:1) the mercury derivative showed a constant melting point at 137-138° C.

The following conclusions can be drawn from the formation of the above mentioned derivatives:

The formation of dibromide, which on further bromination could not be transformed into tribromide, points towards the existence of two alkyl groups in the thiophene nucelus. The solubility of the mercury compound (5) in alcohol shows that there is only one alpha position substituted in the thiophene nucleus. Consequently it should be assumed that there exists one 2,3- or 2,4-methylethylthiophene homologue which gives the alcohol soluble mercury derivative, m.p. 137-138° C. This conclusion, however, seems to be doubtful for the reason that 3-isopropylthiophene gives a 3-isopropylthiophene mercury chloride, m.p. 137° C., identical with the melting point of the above mentioned homologue.

The alcohol-insoluble portion of the precipitated mercury compounds did not show any sharp melting point and at 176° C. the substance began to darken. Since this insoluble portion, being composed of a mixture of thiophenes contaminated with oil, could not be purified by recrystallization, it could not throw much light on the reactions; in further experiments, only the mixture of thiophenes, $d_{20°} = 0.9510$, was investigated.

The following compounds were prepared from this original material, $d_{20°} = 0.9510$:

(1) By bromination, apparently mixtures of dibromides which during the redistillation were coming over between 225-234° C. Repeated bromination of these substances did not give any tribromide; the analyses pointed rather towards the presence of dibromides.

(2) Acetylation in the presence of aluminum chloride gave a reaction product lacking any uniformity due to the existence of two different fractions, each having a different boiling point; during the redistillation the first cut came over between 225-227° C., $n_D^{20°} = 1.5352$.

(3) When the original (not fractionated) reaction product from the acetylation was heated with paranitrophenylhydrazine in an alcoholic solution, reddish-brown crystals fell out upon the cooling of the solution. These showed a certain uniformity and melting point of 140° C. After many recrystallizations from ethyl acetate two hydrazones were obtained:

(a) The slightly soluble para-nitrophenylhydrazone, m.p. 166-167° C., brownish-red globules, which was identical with para-nitrophenylhydrazone obtained from the decomposed mercury compound, soluble in alcohol;

(b) The soluble para-nitrophenylhydrazone, m.p. 123-124° C., crystallizing in brick-red needles.

It is worth while to compare the melting points of these hydrazones with those obtained from propyl- and isopropylthiophenes, resp.:

2-isopropylthiophene
para-nitrophenylhydrazone b.p. 209-210° C. at 18 mm.
2-propylthiophene
para-nitrophenylhydrazone m.p. 205° C.
3-isopropylthiophene
para-nitrophenylhydrazone m.p. 141° C.
3-propylthiophene
para-nitrophenylhydrazone m.p. 170-171° C.

It is possible that the hydrazone, m.p. 166-167° C. could be identified as 3-propylthiophene, m.p. 170-171° C.[5], the difference in the melting point being only 4° C. On the other hand, the data pertaining to 3-isopropylthiophene derivatives agree to a certain degree with our observations: "The acetothienone was not obtained as a homogeneous product, its oxime being yellowish uncrystallizable oily droplets, while its para-nitrophenylhydrazone crystallized in brownish-yellow needles, m.p. 141° C." Actually we also obtained in the beginning para-nitrophenylhydrazone, m.p. 140° C., but after numerous recrystallizations we were able to separate it into two derivatives, m.p. 166-167° C. and m.p. 123-124° C.

The fact that the mercuric chloride derivative is soluble in alcohol points towards the absence of 3-isopropylthiophene or 3-propylthiophene as the main reaction product. Apart from the color reaction with phenanthraquinone, which for 3-propylthiophene is reported to be olive-green and which in this case is violet, the absence of the formation of a tribromide substitution product is most striking and indicates the presence of isomers of methylethylthiophene as the main reaction product. It is a surprising fact that nobody ever resorted to the bromination of thiophenes isolated from ichthyol or from Kimmeridge shale oil.

There is no question that at present our statements lack certain supporting data, but we will endeavor to obtain more experimental facts on the reaction mechanism of thiophene mixtures obtained from heptane. Additional experiments will also be conducted in order to ascertain whether any rearrangements take place during the acetylation in the presence of aluminum chloride which are probably absent when using stannic chloride. Similar observations were made in other investigations. Likewise it has been proved that during the dehydrogenation of ring systems rearrangements take place, for example, the isomerization of dicyclopentyl derivatives (and homologues) in naphthalene and in alkylated naphthalene[6];

for this reason it will be necessary to devote more attention to this problem.

Methylthiophthene, $C_7H_6S_2$

As indicated by the distillation curve No. 2 of the residuum, the density of the fractions from 3 to 6 increases with the sharp rise of the temperature. After a careful redistillation of these four fractions, cuts were obtained which, on treatment with picric acid, furnished a light-orange picrate. On basis of this picrate it was possible to isolate methylthiophthene, $C_7H_6S_2$, and to prove its identity by preparing a series of its derivatives. The picrate, originally obtained, still retained a certain portion of a heavy oil actually belonging to the next fraction and it was possible only after a repeated crystallization to obtain the compound in the form of fine needles, m.p. 110-111° C. After heating the picrate with dilute sodium carbonate solution on the water bath and then drying and distilling the remaining heavy orange-colored oily layer, a fraction was obtained having the following constants: b.p. 232-234° C. at 590 mm., $d_{20°} = 1.1171$, $n_D^{23°} = 1.627$. Due to its properties the fraction does not give the sharp color reaction with isatine; the oil has a typical odor resembling naphthalene. The raw product solidifies in crystals between —12° and —13° C., whereas the methylthiophthene purified (by means of picrate) and redistilled several times solidifies at —4° C. Some years ago the author prepared synthetic dimethylthiophthene, $C_8H_6S_2$, by the action of sulphur upon normal octane under pressure. Now he has also succeeded in isolating its next lower homologue, methylthiophthene, using normal heptane as a starting material and obtaining the following derivatives of methylthiophthene:

(1) *By bromination:* A solution of methylthiophthene in carbon disulfide when acted upon with an excess of bromine yields fine silvery needles, m.p. 154° C. after recrystallization from benzol. On the basis of the bromine determination this compound is identified as tribrom-methylthiophthene, $C_7H_3Br_3S_2$.

(2) *By acetylation:* Using the raw thiophthene as a starting material and aluminum chloride as a catalyst, the yield of the resulting ketone is insignificant and the reaction is accompanied by the separation of tarry products. On the other hand the yield is theoretical when the redistilled oil, obtained from the decomposition of the picrate, is used as the starting material together with stannic chloride as catalyst. It is also recommended that the crystalline acetyl derivative be boiled with animal char when recrystallizing from alcohol; this operation gives white crystals of 87° C. melting point and corresponding to the formula $C_9H_8S_2O$.

(3) When the ketone obtained by (2) is reacted in an alcoholic solution with 2,4-dinitrophenylhydrazine (dissolved in the smallest possible volume of concentrated sulfuric acid), a separation of dark-red crystalline products takes place immediately. These products are very slightly soluble in all solvents including ethylacetate; m.p. 253-254° C.

(4) Likewise, the prepared para-nitrophenylhydrazone hardly differs in appearance from the above-mentioned products, except that it is more soluble; m.p. 232-233° C.

(5) Finally the styphnate of methylthiophthene was also prepared, a compound very similar to the picrate as far as the crystalline form and the color are concerned. Its color, however, has a slightly lighter yellowish shade. The styphnate is very soluble in alcohol and in other solvents and due to this high degree of solubility many recrystallizations had to be made before a sharp melting point, 98-99° C., was obtained. Attempts have been made to obtain a further homologue of thiophthene by the reduction of the carbonyl group of the acetyl compound according to the Clemmensen's method (amalgamated zinc and hydrochloric acid). However, the available amount of the starting material proved to be insufficient in order to obtain any further data.

Transformation of Thiophene $C_7H_{10}S$ Into Methylthiophthene $C_7H_6S_2$

As the original aim was to study the mechanism of the reaction step by step the thiophene fraction, $d_{20°} = 0.9213$, not dehydrogenated by means of selenium, was heated with sulphur under a reflux for 6 hours. The reaction product was left to stand over night and the next day it was found that a crystalline sulphur deposit had separated. The solution was filtered and distilled. At the beginning only thiophene came over, then the temperature rose to 220° C.

A significant volume of the charge distilled over between 220-238° C. with the characteristic odor of methylthiophthene, which later was identified by means of the picrate compound and which showed a melting point of 110-111° C. after the first recrystallization.

In this connection reference should be made to the above-mentioned research work relative the formation of the thiophene, $C_8H_{12}S$, and the dimethylthiophthene, $C_8H_8S_2$, from normal octane and sulphur as starting materials. At that time the author presumed, without having any experimental proof on hand, that the thiophthene derivative was being formed from the thiophene derivative. During later studies of this reaction, not yet published, it was possible to obtain a high yield of dimethylthiophthene when heating the thiophene derivative with sulphur under reflux.

These observations, being consistent with each other, led the author to synthesize ethyl- and propylthiophene according to the following scheme:

Thiophene	Thiophene
↓	↓
Acetylthiophene	Propionylthiophene
↓	↓
Reduction according to Clemmensen	Reduction according to Clemmensen
↓	↓
Ethylthiophene	Propylthiophene

and to heat the resulting pure thiophenes, with sulphur under reflux for 6 hours. It was not possible to prove the transformation of ethylthiophene into thiophthene, nor the transformation of propylthiophene into methylthiophthene, reactions which can not be overlooked when resorting to testing with picric acid.

The absence of reaction when using pure thiophene as starting material and its occurrence when using not completely dehydrogenated fractions, can be explained as follows: The original ring compounds, formed by the action of sulphur upon hydrocarbons and containing sulphur in the bridge structure, represent mixtures without any doubt. They are not only mixtures of isomeric $C_7H_{10}S$ compounds, but in many cases the analyses show a strikingly high hydrogen content, too high for pure thiophene, e.g. for $C_8H_{12}S$, which has been prepared from normal octane. The calculated hydrogen content was 8.57

percent by weight, whereas the analysis showed 9.07 percent by weight,[1] the specific gravity showed only $d_{21°} = 0.9386$.

Consequently the following hypothesis may be proposed: Tetrahydrothiophene as well as partially and/or completely dehydrogenated thiophane (i.e. thiophene) are contained in the initial mixtures, the component ratios of which can not be determined. They depend mostly upon the duration of the reaction, the temperature and the amount of sulphur used. In addition there are present, in all probability, the partially dehydrogenated intermediate compounds which are the very carriers of the reaction itself. Other work carried out along similar lines showed the probability of the stepwise dehydrogenation of ring systems by the action of sulphur. When working with cyclohexane, C_6H_{12}, the author was able to establish that it could be transformed into thiophenol, C_6H_5SH, after having been heated with sulphur, whereas the completely dehydrogenated cyclohexane, i.e., benzene, C_6H_6, would not react, except in the presence of aluminum chloride catalyst. Likewise tetrahydronaphthalene was transformed into dinaphthothiophene by heating with sulphur, whereas a similar reaction takes place with naphthalene only at red heat.

Similarly the hydrogens in the partially or completely hydrogenated thiophenes are reactive toward sulfur, making possible in this case the formation of thiophthene by ring closure, the hydrogen leaving the molecule as hydrogen sulfide.

Other views on the question of the formation of the described thiophthene and its structure seem also to have certain merits, e.g. those of A. E. Dunstan: "Friedmann's work is very suggestive but one could not help thinking that these bodies ($C_8H_{12}S$, $C_8H_8S_2$), were simplification products of far more complicated structure in the original bituminous material."[7]

Conversion of the Last Fraction into Methylthiophthene

The author fully agrees with Dunstan that sulphur compounds, present in the original bituminous material and still not definitely isolated, must have a very complicated structure.

The views of Dunstan and of the author can now be brought down to a certain common basis:

It was not possible to isolate from the odorous Fraction, $d_{20°} = 1.1471$, boiling range 240-295° C., a uniform compound which would throw some light upon the constitution of the products in question. However, when this fraction was heated with selenium for 4 hours under reflux, and the product (which had a very much improved odor) was separated from the selenium and redistilled, the typical odor of thiophthene could be detected in the distillate, b.p. 220-235° C. at 586 mm. It was also possible to produce methylthiophthene, $C_7H_6S_2$, in the form of its picrate, m.p. 110-111° C., which was identical with that obtained during the main reaction. Heating this Fraction, $d_{20°} = 1.1471$, with sulphur under reflux for 4 hours had the same effect; after this operation a large portion of methylthiophthene distilled over between 220-240° C. and it could be identified by the melting point of its picrate, 110-111° C. During the reaction with sulphur the formation of asphaltic residua (soluble in carbon tetrachloride, benzene, carbon disulfide) was far greater than when heating with selenium.

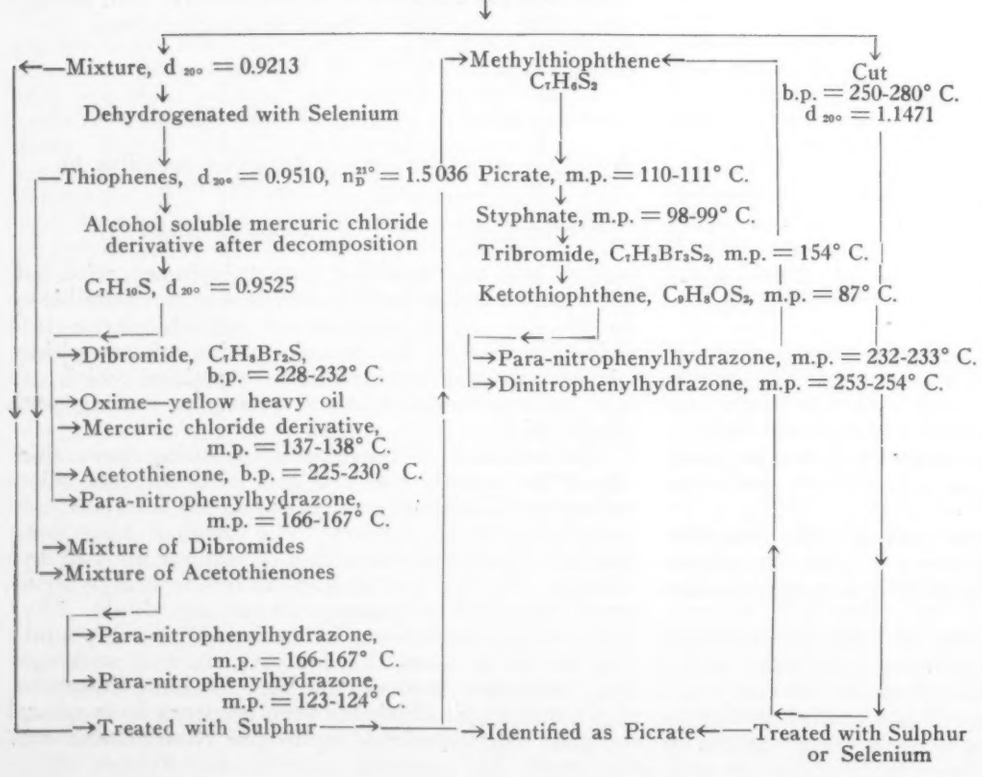
Besides methylthiophthene a solid compound of a greenish-yellow color has been isolated from the last reaction; however, its composition has not been investigated as yet.

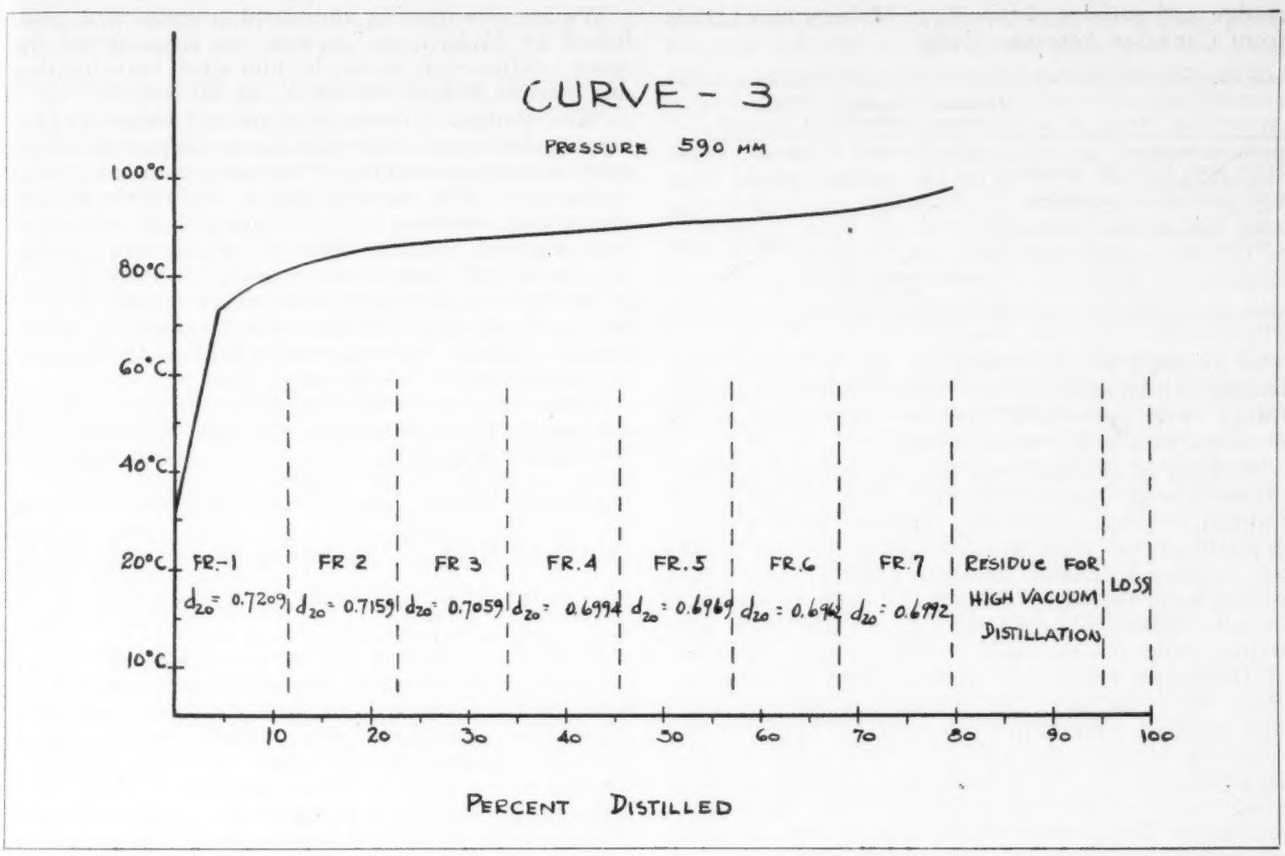
The dehydrogenation of the last Fraction, b.p. 250-280° C., suggests methylthiophthene as one of the intermediate products, as well as a simplification product of a more complicated structure. Due to the loss of hydrogen the molecular equilibrium seems to be destroyed to such an extent that the loose bonds break and only the double ring of thiophthene remains.

Before closing it should be mentioned that methylthiophthene was heated under reflux with sulphur also; the splitting of the hydrogen results here in the formation of asphaltic bodies which could not be investigated more fully.

Table 1 gives the summary of the described experimental work.

TABLE 1
Normal Heptane, $d_{20°} = 0.6836$ + Sulphur under pressure


Mixture, d 20° = 0.9213
Dehydrogenated with Selenium
Thiophenes, d 20° = 0.9510, n D 21° = 1.5036
Alcohol soluble mercuric chloride derivative after decomposition
C7H10S, d 20° = 0.9525
→Dibromide, C7H8Br2S, b.p. = 228-232° C.
→Oxime—yellow heavy oil
→Mercuric chloride derivative, m.p. = 137-138° C.
→Acetothienone, b.p. = 225-230° C.
→Para-nitrophenylhydrazone, m.p. = 166-167° C.
→Mixture of Dibromides
→Mixture of Acetothienones
→Para-nitrophenylhydrazone, m.p. = 166-167° C.
→Para-nitrophenylhydrazone, m.p. = 123-124° C.
→Treated with Sulphur
→Methylthiophthene C7H6S2
Picrate, m.p. = 110-111° C.
Styphnate, m.p. = 98-99° C.
Tribromide, C7H2Br3S2, m.p. = 154° C.
Ketothiophthene, C9H4OS2, m.p. = 87° C.
→Para-nitrophenylhydrazone, m.p. = 232-233° C.
→Dinitrophenylhydrazone, m.p. = 253-254° C.
Cut b.p. = 250-280° C. d 20° = 1.1471
→Identified as Picrate
Treated with Sulphur or Selenium



(II). Isooctane (2,2,4-Trimethylpentane)

For the purpose of continuing the earlier experiments of the author in which 24 g. of sulphur was used for 100 g. of normal octane,[8] experiments 1 and 2 (see below) were started with isooctane, $d_{20°} = 0.6917$, using the same quantity of sulphur. Following up the earlier deductions, the amount of sulphur added was decreased to 18 g. the time of reaction being 18-20 hours and the temperatures from 275-285° C. (experiments 3,4,5). The same autoclave with shaking arrangement which was used in the heptane investigations, was also used in the above experiments. The reaction pressure rose as high as 45 atmospheres for some time, but it fell off during the last experimental period, giving a reading of 21 atmospheres. The isooctane loss was 22 percent by volume. Later on the specific gravities of the reaction products, the distillates and the residua, obtained from these five experiments, were tabulated:

Experiment No.	1	2	3	4	5
Reaction Product, $d_{20°}$	0.738	0.734	0.719	0.720	0.725
Distillate (80% vol. charge), $d_{20°}$	0.698	0.699	0.693	0.692	0.698
Residuum (15% vol. charge), $d_{20°}$	1.003	0.983	0.878	0.873	0.868

After cooling the reaction product in an ice-salt mixture, a small amount of gold-yellow crystals separated out from the deep-brown liquid. These crystals were collected on the filter and treated separately. The determination of the structural formula of this compound assisted us in explaining the mechanism of the reaction to a certain extent, which will be discussed later on.

Taking under consideration the Curve 3, the distillation curve of the reaction product, we find that the first fraction, $d_{20°} = 0.7209$, shows the highest specific gravity. This gradually decreases until it shows $d_{20°} = 0.6962$ for the sixth fraction. Due to the content of sulphur compounds all fractions have a very unpleasant odor; it has been found that the sulphur content of the first fraction was 6.32 percent (bomb). On the basis of these findings the fractions were redistilled and the first portions of the distillate shaken with the aqueous solution of mercuric chloride. Immediately a large amount of mercury derivative was precipitated; it was filtered off, dried and carefully decomposed at a low temperature. The separated oil, having a very unpleasant odor and a high volatility, was oxidized with an excess of perhydrol. An oxydation product was obtained showing a melting point of 108-109° C., by means of which it was identified as dimethylsulfone, $(CH_3)_2SO_2$.

No success, however, was obtained when investigating the fraction boiling between 85-90° C. After several redistillations the boiling point rose to 86-88° C. and the sulphur content showed 4.25 percent. The mercury derivative, however, was not a uniform compound, but was in all probability a mixture of diethylsulfide and methylethylsulfide. In any case it may be assumed that isooctane is decomposed during the reaction and that one or more of the isooctane fragments react with sulphur under the influence of pressure and temperature. Other distillates have, as yet, not been investigated.

Reaction Products Obtained from High Vacuum Distillation (See Curve 4)

The first fraction distills over between 42-51° C., $d_{20°} = 0.8927$, $n_D^{21°} = 1.4696$. It is of interest to compare the above constants with those obtained by McKittrick[9] who investigated the 8-carbon-atom sulfides isolated from California pressure distillate

sludge and sulfides obtained by Mabery and Quaile from Canadian kerosene sludge:

	Carbon atoms	Boiling Point °C.	$d_{20°}$	n_D
Normal alkyl sulfide	8	182	0.839	1.454
Sulfide from California pressure distillate sludge	8	162–168	0.900	1.468
Sulfide from Canadian kerosene sludge	8	167–169	0.892	1.468
Sulfide from the above reaction product	8	157–166 at 591 mm.	0.8927	1.4696
	(calc.)	→ 169–177 at 760 mm.		

The findings of McKittrick for his product, "The boiling points, densities and refractive indices show a rather close agreement," closely correspond to the distillate obtained from isooctane.

McKittrick also discloses that he obtained addition products with mercuric chloride while working with California pressure-distillate sludge; after five recrystallizations they showed sharp melting points but contained variable amounts, namely, from 2 to 4 molecules of mercuric chloride (probably mixtures of various addition products). F. Challenger[10] also writes about the mercuric chloride addition product of thiophane which he obtained from Kimmeridge shale oil, as follows: "With mercuric chloride additive products were found, but were not obtained in a condition suitable for analysis." We could confirm the observations of both investigators but have to remark that these addition products, due to the reasons quoted by McKittrick himself and in spite of many recrystallizations, do not represent pure compounds which could be successfully analyzed.

We are also quoting additional statements as published by McKittrick, because we encountered the same conditions as shown by him when investigating our fraction of b.p. 158-166° C. at 591 mm.:

"The sludge oil reacts with methyl iodide to give water soluble crystalline sulfonium compounds which sublime without melting. They give double addition compounds with methyl iodide and with methyl iodide and iodoform . . . Oxidation with potassium permanganate yields sulfones which are yellow liquids slightly soluble in water . . . With methyl iodide the reaction goes much more readily than it does with the alkyl sulfides, and the tendency to exchange radicals, forming methylsulfide and methyl sulfonium iodide, is very much less."

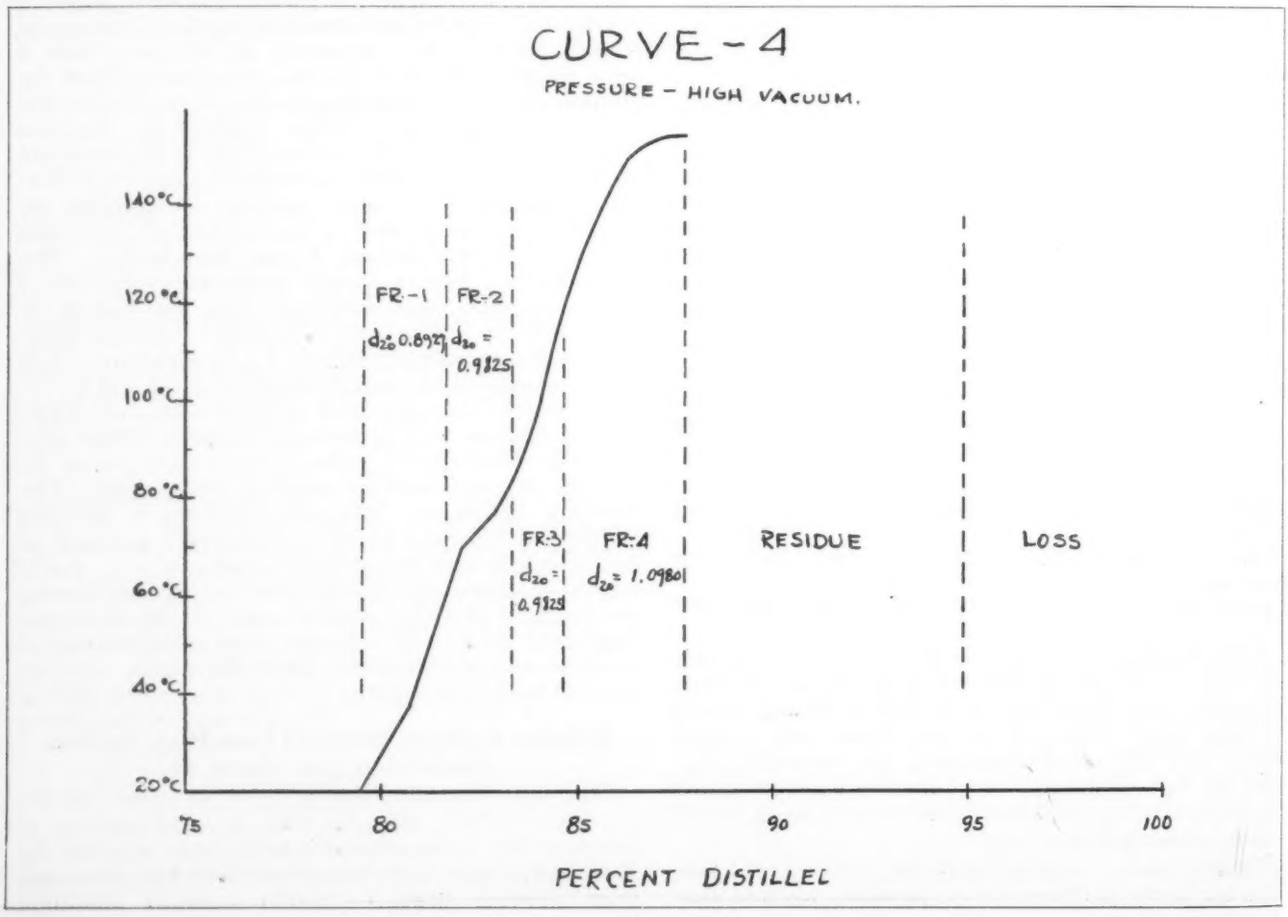
After many redistillations with the fractionating column the fraction 158-166° C. could be divided into the following cuts:

(a) Cut 157-160° C., $d_{20°} = 0.9021$, approximately 65% by vol. of charge

(b) Cut 168-171° C., $= 0.9083$, approximately 30% by vol. of charge

(c) Cut 176-179° C., $= 0.9145$, approximately 5% by vol. of charge

None of the above fractions showed the thiophene reaction; their odor was intolerable and any manual handling of these bad-smelling products eventually affects the central nervous system. Besides these obstacles and having only small quantities available, we had to set aside a certain amount of clean fractions to be used as a comparative material in our studies of the Panuco crude oil which contains quite a significant percentage of thiophanes. The sulphur compounds occurring in the above crude will be dis-



cussed in detail later on in the report dealing also with derivatives obtained from isooctane.

Experiments with the Fraction Boiling 157-160° C.

(1) Bromination with bromine in carbon disulfide or in other solvents or with bromine water, gives a liquid derivative which decomposes spontaneously with the evolution of hydrogen bromide.

(2) By the action of aqueous solution of mercuric chloride upon the product, dissolved in heptane, mercury addition compounds are formed. The seemingly well crystallized compounds represent mixtures of addition products with one or more molecules of mercuric chloride. Their separation could not be accomplished due to the scarcity of the material.

(3) An addition product was obtained with platinum chloride, the liquid showing a red color and corresponding to the formula: $(C_8H_{16}S)_2PtCl_4$.

(4) The oxidation with an excess of perhydrol in glacial acetic acid solution into sulfone progressed easily; this sulfone is a light-yellow, viscous oil, $d_{20°} = 1.187$, contaminated with a small amount of free sulfuric acid.

(5) When heated on the water bath with methyl iodide, a formation of a brown crystalline mass took place. After pressing on the porous clay plate this mass became lighter and it readily crystallized from methanol in a form of fine, light-yellow colored needles, $C_8H_{16}SCH_3I$. After the recrystallization these needles do not show any true melting point but they sublime about 95-96° C.

(6) A partial transformation of the fraction 158-161° C. into thiophene and into a solid compound, m.p. 86° C., occurred upon heating with sulfur under reflux; 10 g. of the fraction was heated under reflux with 2 g. of sulphur for 10 hours. After cooling and setting aside for the night no sulphur separated. The distillation results were as follows:

Fraction	Volume	Remarks
IBP-134° C.		
158-170° C.	5 cc	It gave an intensive green color reaction with isatine;
176-178° C.	2 cc	
180-195° C.	1 cc	Intensive red colored distillate;
Residuum	1 cc	Solidifies upon cooling.

Using the indophenine reaction (isatine + concentrated sulfuric acid) it was possible to prove the presence of thiophene, $C_8H_{12}S$ (also the transformation of this fraction into thiophenes); from this one can deduct that the original fraction contains thiophanes or partially dehydrogenated thiophanes and that sulfides containing rings are formed by the action of sulphur upon isooctane.

The residuum, which upon cooling became solid, was dissolved in a small quantity of benzol and, upon addition of a small portion of absolute alcohol, a large amount of gold-yellow crystals was obtained by allowing the mixture to stand over night; in addition there were also other crystals present in the main portion. These crystals were pressed on the porous clay plates, recrystallized twice from glacial acetic acid after which they melted sharply at 86° C. The compound obtained from the original reaction product by freezing out shows the same melting point and a like appearance. The herein described formation of the compound, m.p. 86° C., permits the statement that this product represents a thiophane derivative.

(7) Dehydrogenation of the fraction 158-161° C. by means of powdered selenium: Experiment 6 brought out an important point in the progressive action of sulphur upon isooctane. Attempts were now made to split off the hydrogen from the original product, b.p. 158-161° C., and at the same time avoid too much conversion of the starting material due to the action of sulphur. Following this idea the fraction was heated for the total period of 80 hours with powdered selenium under reflux. Due to the low boiling point of the fraction the progress of the reaction was a very slow one, although the hydrogen selenide was coming off from the very beginning. After this protracted action the results accomplished seemed to be very insignificant; however, it was easily possible to obtain a clear color reaction with indophenine, but the bad odor of the fraction continued throughout, thus indicating the unquestionable presence of thiophane. The specific gravity of the fraction boiling at 155-158° C. showed an increase in its constants after the selenium treatment: $d_{20°} = 0.9227$ and $n_D^{15°} = 1.4829$. In addition it was not possible to obtain any sulfonium product with methyl iodide. This also proves that the original content of thiophane was decreased by the equivalent amount of the dehydrogenated rings formed during the reaction. But, as it will be seen from the following experiment, the content of thiophene, $C_8H_{12}S$, was greater than it was indicated by its specific gravity.

(8) Acetylation and propionylation of the dehydrogenated product obtained from the Experiment 7: In one experiment the dehydrogenated fraction was treated with acetyl chloride and aluminum chloride. Besides heavy reaction products, it actually was possible to identify an acetoketone from the fruit-like odor of the distillate. On basis of earlier experiences it was thought better to prepare the propionylketone, $C_{11}H_{16}SO$, by means of stannic chloride. The reaction progressed fairly well; during the distillation of the reaction product, besides first runnings, an oil of a light-yellow color and of a pleasant odor came over between 242-255° C. which, after repeated redistillations, showed b.p. 240-245° C., $d_{20°} = 1.1005$ and left a small amount of residuum.

(9) Without a complete purification, the propionylketone, $C_{11}H_{16}SO$, (as described under 8) was boiled with 2,4-dinitrophenylhydrazine in an alcoholic solution with a later addition of a small amount of concentrated hydrochloric acid. After cooling a red-brownish resin separated out at first and the liquid was decanted. From the transparent solution of the reaction product dark-red crystal of hydrazone separate out; later on they had to be recrystallized from ethyl acetate several times before the resinous matter was completely removed. Also, the first resinous product solidified in the form of crystals after being washed with petroleum ether. The hydrazone obtained at the beginning, m.p. 172-174° C., corresponded to the formula: $C_{17}H_{21}SN_2O_4$.

Fractions Boiling 168-171° C. and 176-179° C.

For the purpose of identification of these fractions the same procedure was used as described before; as long as the material was available, the derivatives were prepared, but the experiments were by no means concluded. After a long treatment of both fractions with powdered selenium (which during this operation changes its structure into a hexagonal form) a typical thiophene color reaction (isatine + concentrated sulfuric acid) was obtained in both cases. The 168-171° C. fraction had a green color with a bluish tinge. After the treatment of the fraction with selenium it distills over between 162-165° C., $d_{20°} = 0.9244$, $n_D^{16°} = 1.4842$; its sulfone shows practically

the same specific gravity, namely, $d_{20°} = 1.1688$, as obtained from the fraction 157-160° C. The fraction 176-179° C., after the treatment with selenium, distills between 167-169° C., $d_{20°} = 0.9268$, $n_D^{16°} = 1.4880$.

All further deductions will be withheld for the time being until we come back to these fractions, when we will also discuss the sulphur compounds with 8 carbon atoms isolated from Panuco crude oil.

Summarizing the above it can already be established that the distillate coming off first from the isooctane reaction and boiling between 158-166° C. at 591 mm. can be regarded as a mixture of three isomeric thiophanes having 8 carbon atoms and which, by splitting off the hydrogen, can be transformed into the corresponding thiophenes, $C_8H_{12}S$.

Fraction, $d_{20°} = 0.9361$, Obtained Under High Vacuum

This fraction has not as yet been fully investigated and it is not possible to state whether it contains higher open-chain sulfides appearing as reaction products of fragments of isooctane and sulphur.

Fraction, $d_{20°} = 0.9825$, Obtained Under High Vacuum

This oil of intense red coloration and displaying distinct properties of a dye (solubility in sodium sulfide), comes over when redistilled under high vacuum between 86-95° C., $d_{20°} = 0.9968$. This oil does not give the thiophene reaction, but it can be classified as a thiophane derivative from the following reactions:

(1) An addition product is precipitated immediately with mercuric chloride; it is very slightly soluble in all solvents.

(2) After heating this material on the steam bath with methyl iodide crystalline masses separate out upon cooling which, after pressing on the porous clay plate, display a light-brown color and after recrystallization from methanol seperate as light-yellow needles, m.p. 166° C.

(3) When oxidized with an excess of perhydrol in glacial acetic acid, the red color gradually disappears. After two days of repeated shaking all the oil goes into reaction. After the concentration of the oxidation products there remains a light-yellow viscous oil which contains considerable quantities of sulfuric acid. After removal of the acid, the oil shows $d_{20°} = 1.1902$, another value which approaches the specific gravity figure of the other oxidation products.

(4) During the treatment of the fraction with sulphur the flask cracked and the experiment could not be repeated due to the scarcity of the material.

(5) If the red oil is heated with powdered selenium under reflux a violent splitting off of hydrogen selenide takes place at the beginning. After five hours the reaction slackens and the vapors condensing in the cooler change from red to a very pale yellow color. After the separation of the reaction product from selenium and the subsequent distillation a cut between 150-160° C. is obtained in a high yield, showing no offensive odor and giving a green color reaction with isatine and concentrated sulfuric acid. Consequently we can assume that with the splitting off of hydrogen a thiophene fragment comes out from the complex molecule. The main part of the dehydrogenated fraction, not yet investigated, came over between 250-270° C. leaving an asphalt-like residuum which dissolved readily in various solvents. If the fraction 250-270° C. is treated with a large excess of perhydrol no sulfone is formed and the oil which reacts slightly if at all stays in an upper layer above the perhydrol. In general thiophenes should not be transformed into sulfones by oxidation media.

Fraction, $d_{20°} = 1.0980$. and Residuum Obtained Under High Vacuum

The fraction still contains a certain amount of the red oil, nevertheless it solidifies after cooling into a crystalline mass, similar to the residuum. If redistilled under high vacuum it comes over between 138-141° C., $d_{20°} = 1.1261$ (liquid), and solidifies into crystals later on. This solid portion represents a mixture of two or perhaps three components; after many recrystallizations, first from heptane, then from alcohol, finally from glacial acetic acid, it was possible to obtain in the purified state the main component portion, in the form of compact needles, of reddish-yellow color and melting point 86° C. The sulphur content was 45.47 percent; the calculated sulphur content of a compound $[(C_8H_{16})_2S_6]_x$ shows 46.10 percent. The molecular weight has not yet been determined. The compound burns with vigorous evolution of brown vapors.

This compound proved to be identical with the one described at the beginning of this article and which separates out from the reaction product after freezing out. Much more important is its identity with the compound resulting from the action of sulphur on the 158-161° C. fraction. As it did not give any thiophene reaction its character as a thiophane derivative was proved through this transition. The following reactions were carried out and derivatives prepared:

(1) In concentrated sulfuric acid the compound dissolves completely and can be separated from this solution by the addition of water.

(2) With mercuric chloride a precipitate of canary-yellow needles is quickly obtained, which can be recrystallized from alcohol (0.5 g. per 400 cc. alcohol), and which decompose and blacken above 200° C. After the decomposition of the mercury compound the original compound is regenerated and shows a melting point of 86° C. after crystallization from glacial acetic acid.

(3) After heating this material with an excess of ethyl iodide on the steam bath and subsequent evapaoration of the excess ethyl iodide, the whole mass solidifies in the form of crystals. After pressing them on the porous clay plate and after many recrystallizations it is possible to obtain fine, felt-like, light-yellow needles which, after washing with heptane and one more recrystallization from methanol, show m.p. of 146° C.

(4) All efforts to obtain a brom addition product have failed in spite of varied experimental conditions. There was always decomposition with evolution of hydrogen bromide; this is a characteristic of these products even if they are kept in the dark.

(5) When heated with platinum chloride in an alcoholic solution and cooled subsequently, there is an instantaneous precipitate of micro-crystalline, practically insoluble addition product of an intense red color.

(6) When reduced with zinc and hydrochloric acid under reflux at an elevated temperature a partial reduction takes place and various mixtures, so far not identified, are formed.

(7) The oxidation into sulfone takes place very easily. For this purpose the substance is suspended in glacial acetic acid, then treated with a large excess of perhydrol and heat insulated. It dissolves with the

TABLE 2

Isooctane, $d_{20°} = 0.6917$ + Sulphur under pressure

↓

Octylthiophanes, $d_{20°} = 0.8927$ → Treated with Selenium → Octylthiophenes, $d_{20°} = 0.9247$ → Treated with Sulphur → Propionylthienone, b.p. = 240-245° C. → 2,4-Dinitrophenylhydrazone, m.p. = 172-174° C.

Thiophane polysulfide, m.p. = 86° C. → $[(C_8H_{16})_2S_6]_x$ → Ethyliodide, m.p. = 146° C.

generation of heat and the colored solution becomes colorless. After standing for 3 days (with frequent shaking) the solvent is evaporated and the residue is freed from the last traces of glacial acetic acid by standing in a desiccator filled with caustic soda. A viscous light oil, containing considerable sulfuric acid, remains. After the separation of the acid from the sulfone and drying the latter once more in the vacuum a specific gravity of $d_{20°} = 1.1892$ was established. This sulfone is completely soluble in concentrated sulfuric acid and in larger quantities of water.

On the basis of the above the sulfide nature of the solid compound has been sufficiently proved, as well as its thiophane constitution, by the subsequent transformation of the 158-161° C. fraction into the solid compound. On the other hand it is well known that thiophanes possess a pronounced tendency to form polythiophanes; thus Bost and Conn[11] have synthesized polythiophanes of methyl and dimethylthiophane. It is also known from inorganic chemistry that the molecular size of free sulphur should be assumed to be S_8 for the ordinary temperature, S_6 for the middle range and S_2 for the higher range of temperatures. This ability of sulphur atoms to combine with each other is marked even when other elements are combined with sulphur. In such structures the sulphur atoms are linked together as chains; the heptasulfides, e.g. sodium or calcium polysulfide, Na_2S_7 or CaS_7, are considered to be the upper limit. Even if we disregard the conclusions drawn from these experiments, it seems to be a permissible assumption that with an average temperature of 275-285° C., the sulphur affixes itself to a carbon atom with a ring closure and the sulphur atoms combine with each other in the chain form.

Thus we arrive finally and simply at the formula for the polythiophane or for the thiophane polysulfide, $[(C_8H_{16})_2S_6]_x$, m.p. 86° C.:

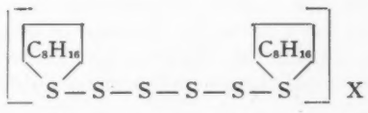
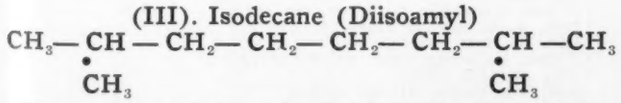


Table 2 gives the summary of the described experimental work.

(III). Isodecane (Diisoamyl)



The purpose of the extended investigations of this hydrocarbon was to study the reaction between sulphur and a branched system, constructed symmetrically and not containing any quaternary carbon atom. The first step of this reaction is similar to the other cases described in the preceeding examples. In the further course of this reaction a thiophthene derivative or a derivative corresponding to polythiophane might be expected; instead, however, a dithienyl derivative has been actually obtained.

If, similar to the conditions set for the experiments with normal heptane and isooctane, 15 g. sulphur is allowed to react with 100 g. isodecane, $d_{20°} = 0.725$, in an autoclave equipped with a shaking arrangement for 18-20 hours at 275-280° C., then enormously high losses take place due to carbonization of the material charged (up to 35 percent by volume). For this reason the amount of reaction products recovered is very small and the yield of the ultimate residuum is approximately 5 percent by volume of the charge. Under these circumstances the work is very difficult and each experimental failure means an irreplaceable loss of the valuable substance.

The Distillation of the Reaction Product

The unreacted isodecane was distilled off till the temperature reached 160° C., b.p. 150° C. at 590 mm.; the distillation cuts were as follows:

Fraction	Remarks
(1) 160-190° C.	A mixture.
(2) 190-210° C.	Identified as thiophene by means of indophenine reaction.
(3) 210-260° C.	A mixture.
(4) 268-280° C.	Solidifies partially; dithienyl derivative.
(5) Residuum	Solidifies partially; dithienyl derivative.

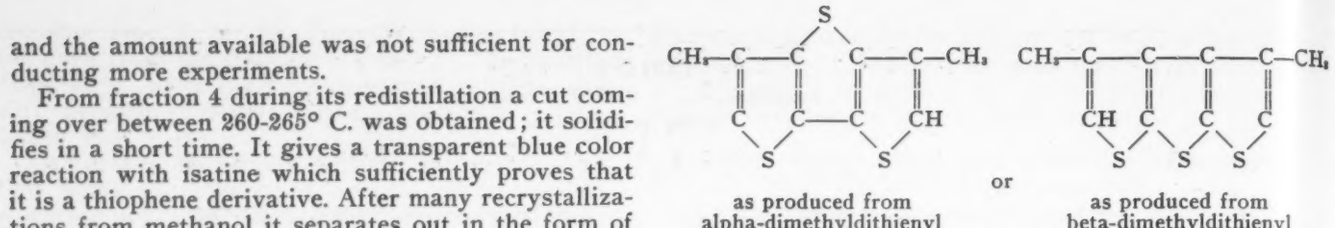
Fraction 2. Thiophene reaction: After repeated distillation it was possible to isolate a thiophene, coming over between 204-207° C. at 590 mm. which showed $C_{10}H_{16}S$, $d_{20°} = 0.9482$, $n_D^{21°} = 1.4842$. For the purpose of its identification a propionylketone was obtained by means of propionyl chloride and tin chloride. The pleasant, fruity-smelling, light-yellow, liquid ketone comes over between 268-278° C. at 588 mm. leaving a residue; b.p. after redistillation 266-270° C.

From the propionylketone, $C_{13}H_{20}SO$, a corresponding hydrazone was prepared by heating the former with 2,4-dinitrophenylhydrazine dissolved in alcohol with an addition of a small quantity of concentrated hydrochloric acid. An oily product is precipitated at first and, after its decantation, the hydrazone separates out in large quantities and in the form of dark-red crystals.

From fraction 3 it was possible to isolate a cut distilling between 222-225° C., $n_D^{21°} = 1.4980$. It neither gave the indophenine reaction nor a picrate

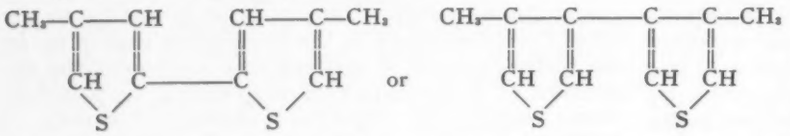
and the amount available was not sufficient for conducting more experiments.

From fraction 4 during its redistillation a cut coming over between 260-265° C. was obtained; it solidifies in a short time. It gives a transparent blue color reaction with isatine which sufficiently proves that it is a thiophene derivative. After many recrystallizations from methanol it separates out in the form of long, white leaves, m.p. 73° C. This compound has the formula $C_{10}H_{10}S_2$; it might therefore be regarded as a thiophthene derivative. However, our derivative did not form any picrate, unlike the 3 isomeric thiophthenes synthesized by F. Challenger[12], methylthiophthene,[13] or dimethylthiophthene[14]; the compound $C_{10}H_{10}S_2$, also exhibits very little of the naphthalene odor which is so typical of thiophthene. Therefore it appears correct to classify the compound as alpha or beta dimethyldithienyl, i.e.:



as produced from alpha-dimethyldithienyl

as produced from beta-dimethyldithienyl



During the bromination of the compound m.p. 73° C. dissolved in a small amount of carbon disulfide, hydrogen bromide splits off at once and in large quantities; a crystalline product separates out quantitatively in a short time which, after two recrystallizations from benzol, gives very long fine white needles, with a silky feel and a formula: $C_{10}H_6Br_4S_2$, m.p. 188-190° C.

Experiments With Dithienyl and Sulphur

After heating the dithienyl product for 4 hours with 10 percent by weight sulphur in a sealed Pyrex tube at 200° C. a high pressure resulting from the splitting off of hydrogen sulfide was noticeable after the tube was opened. The substance itself, however, was so badly carbonized that it was not possible to obtain a derivative. On basis of this experience the large amount of carbonization and loss occurring during the main reaction will be understood. The same compound was later heated at 140° C. for 1 hour only with a smaller amount of sulphur in an open tube. Some of the used substance did not enter into the reaction due to its sublimation; in the meantime the main portion turned into a liquid, changing its color into a deep-red accompanied by the evolution of a large volume of hydrogensulfide. When the resulting reaction product was dissolved in alcohol, a part remained undissolved. This insoluble part was filtered out and heated with enough alcohol under reflux to dissolve it completely. From this solution fine silvery leaves, m.p. 114° C., separated out after cooling. This compound does not give a picrate. No more of this compound was left for further analysis.

From the alcohol-soluble portion of the reaction product garnet-like globules separate out which, after recrystallization show m.p. 94° C. This new derivative gives a picrate which separates out in the form of fine copper-red needles; it can not be recrystallized, decomposing into its components.

With regard to the analytical data, namely, that the derivative of m.p. 94° C. corresponds to the formula $C_{10}H_8S_3$, with three sulphur atoms (found 43.0 percent S, calc. 42.86 percent S), its constitutional possibilities should be taken under the consideration:

The present experimental data seem to be insufficient to substantiate these hypotheses and we must return to this problem after further experimentation with these reaction products.

As in the investigation of normal heptane and isooctane, similar attempts were made here to study stepwise the progress of the main reaction by further action of sulphur upon the fractions resulting from the isodecane reaction. As the amount of the material available for experiments was very small there was nothing else left but to take the remainder of mixtures left from the reactions described and treat them with sulphur. This way, additional quantities of thienyl derivative, m.p. 73° C., could actually be obtained. The question, however, remains unsettled whether the same compound was obtained from thiophene, $C_{10}H_{16}S$, or the fraction 222-225° C. not investigated, or whether it was finally formed as a decomposition product derived from the highly complicated fraction distilling over between 230-280° C.

The question of the value to the petroleum industry of this kind of research work can hardly be answered for the present moment as any opinion based on the facts reported herein would be premature; as long as the investigation program of sulphur compounds occurring in Mexican crudes has not been finally concluded it is logical that no technical recommendations can be made.

One question, however, should be eliminated, namely, the mistake so often committed in regarding a certain predetermined sulphur content in an oil fraction as detrimental and demanding its complete removal. The thiophenic sulphur is practically harmless and therefore a much higher percentage of this form of sulphur can be tolerated, e.g. in gasoline, than the thiophanic sulphur. According to our experiments the last mentioned sulphur compound, when added in a concentration of 0.1 percent S to a normal heptane-isooctane mixture of 65 CFR MM rating, will completely neutralize the anti-knock effect of the addition of 3 cc. tetraethyl lead per gallon of such mixture. On the other hand, the thiophene sulphur added in the same concentration (0.1 percent S) will lower the above anti-knock rating by three octane points only.

Acknowledgment

The author wishes to express his sincere thanks to Mr. Carlos L. Corcuera, Refineries Manager of the Petróleos Mexicanos, Mexico, D.F., for his stimulating interest and the permission to publish the work.

LITERATURE CITED

[1] Ber., 49, 1349 (1916).
[2] J. Am. Chem. Soc., 51, 1566 (1929).
[3] Ber., 49, 2595 (1916). Ber., 52, 1913 (1919).
[4] J. Inst. Petroleum Tech., 12, 122 (1926).
[5] Ber., 54-B, 139-154 (1921).
[6] Ber., 59, 2582 (1926).
[7] J. Inst. Petroleum Tech., 21, 170 (1935).
[8] Ber., 49, 1348 (1916).
[9] Ind. Eng. Chem., 21, 591 (1929).
[10] J. Inst. Petroleum Tech., 12, 108 (1926).
[11] Ind. Eng. Chem., 25, 526 (1933).
[12] J. Inst. Petroleum Tech., 21, 135 (1935).
[13] Compare under I of this paper.
[14] Ber., 49, 1348 (1916).

A Nomograph for Density Corrections of American Oils

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BASED on data which were published by the Bureau of Standards Technologic Paper No. 77, a table of density correction per degree Centigrade was prepared by Stott for American Petroleum Oils.[1] A table for specific gravity corrections for the same oils was published three years previously by Beale.[2] The two tables show the good agreement expected, but Stott's density correction tables possess a greater aptitude for simple mathematical treatment than Beale's and, for this reason, they form the basis of this paper. This may be considered unfortunate as the tendencies in the petroleum industry are towards the universal adoption of the specific gravity and not density. However, the use of the simple table or nomograph presented is, in most cases, sufficient for conversion from one system to the other.

Stott's tables give factor B vs. ρ_{20} in the equation
$\rho_t = \rho_{20} + B(20—t)$
where ρ_t = density of oil at t°C in gms/ml.
and ρ_{20} = density of oil at 20°C in gms/ml.

When B was plotted against ρ_{20} a straight line was obtained for the range 0.615 to 0.845 in ρ_{20}. The factor B was a constant, 66×10^{-5}, for all values of ρ_{20} between 0.845 and 0.965. The equation of the straight line was found to be:

$$B = 0.001937 - 0.001511\ \rho_{20}.$$

The agreement between this equation and the tabulated values of B is shown in the following table; the calculated values of B are given to three significant figures, not because they are deemed more accurate than Stott's original values, but because they can be better used later in constructing the nomograph.

Thus the equation represents accurately the data for ρ_{20} between 0.620 and 0.845; but it has the advantage of continuity and thus can be utilized in constructing a nomograph. For accurate calculations, then,

$$\rho_{t2} = \rho_{t1} + B(t1 - t2) \quad \ldots\ldots (1)$$
$$B = 0.001937 - 0.001511\ \rho_{20} \quad \ldots\ldots (2)$$
$$\rho_{20} = \frac{\rho_{t1} - 0.001937(20 - t1)}{1 - 0.001511(20 - t1)} \quad \ldots\ldots (3)$$

In other words if the density at t1°C is ρ_{t1}, the density at t2°C, ρ_{t2} can be calculated as follows:

(a) Calculate ρ_{20}, the density at 20°C, by using equation (3).

(b) Calculate B, the density correction factor, by using equation (2) and inserting ρ_{20} from equation (3).

(c) Calculate ρ_{t2}, the density at t2°C, by using equation (1) and inserting B from equation (2).

The accuracy will be the same as the accuracy obtained by using Stott's tables directly.

For higher values of ρ_{20} than 0.845, then the equations condense to:

$$\rho_{t2} = \rho_{t1} + 66(t1 - t2) \times 10^{-5}$$

However, for a maximum difference in temperature of 20°C from 20°C, i.e. between 0 and 40°C, ρ_{t1} may be substituted for ρ_{20} in calculating B. Thus

$$B = 0.001937 - 0.001511\ \rho_{t1}$$

with the following maximum error in ρ_{t2} in equation (1):

For a maximum error in ρ_{t2}, B should have a maximum error, i.e. $\rho_{t1} - \rho^*_{20}$ should be a maximum and $t_1 - 20$ should be a maximum of 20. Thus, ρ_{20} will be 0.620, $B = 0.00100$ and $(t_1 - 20) = 20$. Then, $\rho_t - \rho_{20} = B\ (t_1 - 20) = 0.0200$. The error in B is $0.0200 \times 0.001511 = 0.00003$, and total error in $\rho_{t2} = 0.00003 \times 40 = 0.0012$.

Where ρ_{20} is higher than 0.620 and $(t_1 - t_2)$ is less than 40°C the error will be confined to the fourth decimal place. On this basis then,

$$\rho_{t2} = \rho_{t1} + B\ (t_1 - t_2)$$
$$B = 0.001937 - 0.001511\ \rho_{t1}.$$

The nomograph in Figure 1 was constructed to represent these two equations for rapid approximate work and the three previous equations for accurate work. In case it is desired to extend or modify this nomograph, a brief description of the axes and the scales may be of interest.

Axis A has a logarithmic scale of the values of B, as calculated by equation (2), for corresponding values of the observed density. Thus, the reading "0.620" represents log 100, and the reading "0.845 — 0.965" at the bottom of the axis represents log 66. Interpolation on this axis is, therefore, slightly more complex than logarithmic; but probably linear interpolation will not introduce major errors.

Axis B is a logarithmic scale, 1/10 times scale A, representing temperature differences between 1 and 40°C. Interpolations are directly logarithmic.

Axis C represents the product $B\ (t_1 - t_2)$ and has a complex logarithmic scale. The distance between

Change in Density (*B*) in gms/ml. per Degree Centigrade of American Petroleum Oils

ρ_{20}	Calculated $B \times 10^5$	Stott's Value for $B \times 10^5$	ρ_{20}	Calculated $B \times 10^5$	Stott's Value for $B \times 10^5$
0.620.....	100.0	100	0.740.....	81.8	82
0.625.....	99.2	99	0.745.....	81.0	81
0.630.....	98.5	98	0.750.....	80.2	80
0.635.....	97.7	98	0.755.....	79.5	80
0.640.....	97.0	97	0.760.....	78.7	79
0.645.....	96.2	96	0.765.....	78.0	78
0.650.....	95.4	96	0.770.....	77.2	78
0.655.....	94.7	95	0.775.....	76.4	77
0.660.....	93.9	94	0.780.....	75.7	76
0.665.....	93.2	93	0.785.....	74.9	75
0.670.....	92.4	92	0.790.....	74.2	74
0.675.....	91.6	92	0.795.....	73.4	74
0.680.....	90.9	91	0.800.....	72.6	73
0.685.....	90.1	90	0.805.....	71.9	72
0.690.....	89.4	90	0.810.....	71.1	72
0.695.....	88.6	89	0.815.....	70.4	71
0.700.....	87.8	88	0.820.....	69.6	70
0.705.....	87.1	87	0.825.....	68.8	69
0.710.....	86.3	86	0.830.....	68.1	68
0.715.....	85.6	86	0.835.....	67.3	68
0.720.....	84.8	85	0.840.....	66.6	67
0.725.....	84.0	84	0.845.....	65.8	66
0.730.....	83.3	84	0.850—.965	....	66
0.735.....	82.5	83			

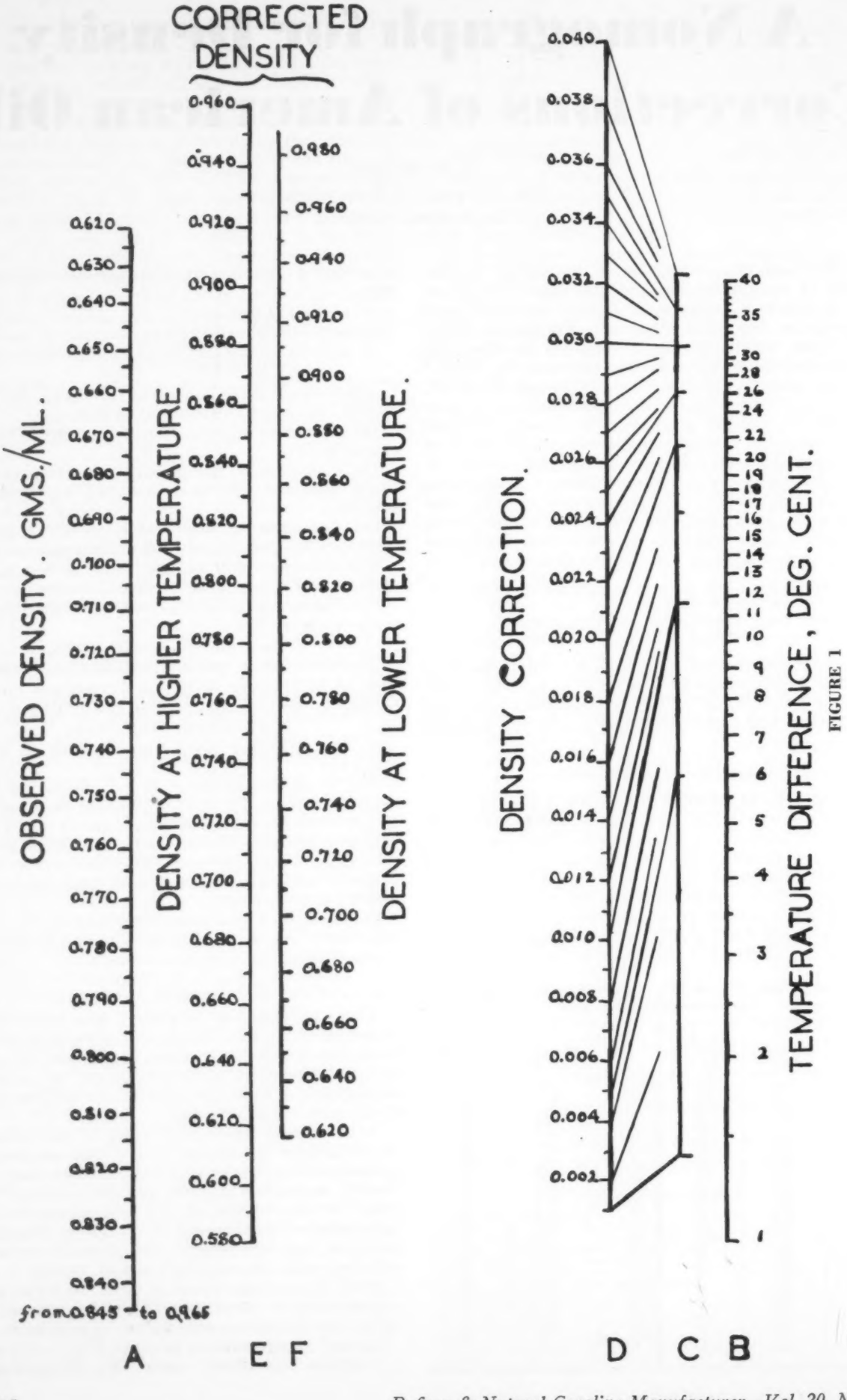

CORRECTED DENSITY
OBSERVED DENSITY. GMS./ML.
from 0.845 to 0.965
DENSITY AT HIGHER TEMPERATURE
DENSITY AT LOWER TEMPERATURE.
DENSITY CORRECTION.
TEMPERATURE DIFFERENCE, DEG. CENT.
A
E F
D C B

FIGURE 1

A and C is 10 times the distance between C and B. It was graduated graphically, by joining the point 0.620 on A (representing 0.001) to various values of $(t_1 - t_2)$ on scale B and graduating the intersection on C, 0.001 $(t_1 - t_2)$.

Axis D converts the readings on C to a linear scale and thus represents B $(t_1 - t_2)$ linearly. Its construction is arbitrary and self-evident. Axis D was so placed as to expand the readings on the upper part of Axis C and to contract those on the lower part.

Axis E is a linear scale of densities. Its place and scale determine the position and scale of

Axis F, which represents the sum of the values on axes D and E. Interpolation on both E and F is linear.

To use the nomograph in converting an observed value of the density to the corrected value at $\pm(t_1 - t_2)$ temperature difference in °C a straight line should be drawn joining the value of the density on A to the value of $(t_1 - t_2)$ on B, intersecting the dummy scale C. A line should then be drawn parallel to the nearest sloping line joining the intersection on C to the value of the density correction B $(t_1 - t_2)$ on D. This value of B $(t_1 - t_2)$ is then joined by a straight line to the value of the density on E, if $(t_1 - t_2)$ is positive, i.e. the temperature of observation of density is higher than the temperature of the corrected density, and the corrected density is read on F. If $(t_1 - t_2)$ is negative, i.e. the observed temperature is lower than the corrected density, then the value of B $(t_1 - t_2)$ on D should be joined to the density value on F, and the corrected density read on E directly.

The following examples will illustrate the use of the nomograph under different conditions:

Example 1.

Reading of density hydrometer in the oil at 20°C 0.7950 gms/ml.

What is the corrected density at 10° C.?

Solution 1.

Temperature difference is +10°C.

Joining 0.7950 on A to 10.0 on B, and following the nearest parallel line between intersection on C to D gives a density correction of 0.0075. Joining 0.0075 on D to 0.7950 on E, gives corrected density on F, of 0.802.

The corrected density, from Stott's tables directly is 0.8024. If greater accuracy is required from the nomograph then 0.0075 should be added to 0.7950, giving 0.8025.

Example 2.

Reading of density hydrometer in the oil at 20°C. is 0.8535 gms/ml.

What is the corrected density at 35°C.?

Solution 2.

Temperature difference is —15°C.

Reading is above 0.845, thus joining point 0.845 on A to 15.0 on B, and following the nearest parallel line between intersection on C and D gives a density correction of 0.0100. Joining 0.0100 on D to 0.8535 on F gives corrected density on E of 0.844.

The corrected density from Stott's tables directly is 0.8436. If greater accuracy is required from nomograph then 0.0100 should be subtracted directly from 0.8535 giving 0.8435.

Note the use of scales E and F reversibly with the 2 examples.

Example 3.

Reading of density hydrometer in the oil at 40°C. 0.7150 gms/ml.

What is the corrected density at 20°C.?

Solution 3.

Temperature difference is +20°C.

Joining 0.7150 on A to 20 on B and following the nearest parallel line between intersection on C to D gives a density correction of 0.0172. Joining 0.0172 on D to 0.7150 on E gives a corrected density on F of 0.732.

The corrected density, from Stott's tables, is 0.7316 (using the successive approximation method of obtaining ρ_{20} roughly first to determine B and then recalculating ρ_{20} by means of this value of B). Equations (1), (2) and (3) may be used instead.

It is noticed that when the density correction 0.0172 is added to 0.7150 the result is 0.7322, which is not a better result than that obtained by adding nomographically as in the two preceding examples. This is due to the fact that the value of 0.7150 was used to obtain the density correction. To obtain a better agreement when the observed temperature is far removed from 20°C., a different method of using the nomograph is to be employed, i.e. the approximate value of ρ_{20} should first be found using the nomograph and then using this approximate ρ_{20} the density correction is determined for the temperature difference. Thus:

Solution 3a.

Using solution 3, the approximate value of ρ_{20} is found nomographically to be 0.732. Joining 0.732 on A to 20 on B and following nearest parallel line between intersection on C to D gives a density correction of 0.0168. Either by adding this correction to the value 0.7150 by means of the nomograph, or ordinarily, yields a corrected density value of 0.7318.

Example 4.

Reading of density hydrometer at 50°C. is 0.6600.

What is the corrected density at 90°C.?

Solution 4.

Temperature difference is —40°C.

Joining 0.6600 on A to 40 on B, and following the nearest parallel line between intersection on C to D gives a density correction of 0.0380. Joining 0.0380 on D to 0.6600 on F gives a corrected density on E of 0.622.

The corrected density from Stott's tables is 0.6240. Thus the error is excessive due to the fact that the nomograph has been used outside the limitations imposed upon it by construction. To obtain a correct answer the problem should be brought within the limitations of the nomograph, thus:

Solution 4a.

The density at 20° C. is first found thus: Temperature difference is +30°C. Joining 0.6600 on A to 30 on B, and following the nearest parallel line between intersection on C to D, gives a density correction of 0.0280. Joining 0.0280 on D to 0.6600 on E gives a corrected density on F of 0.688. This is the approximate value of ρ_{20}.

Using the approximate value of ρ_{20}, the density correction for (50 — 90) °C. is found, by joining 0.688 on A to 40 on B and following nearest parallel line connecting intersection on C to D, and this is 0.036. Joining 0.036 on D to 0.6600 on F gives the corrected value of density at 90° C. of 0.624.

Solution 4b.

The more accurate value of ρ_{20} is found by the method of solution 3a, i.e. joining the approximate value of 0.688 on A to 30 on B the density correction is found to be 0.027. Thus the accurate value of $\rho_{20} =$ 0.6870.

The density at 90°C. is then found from the density

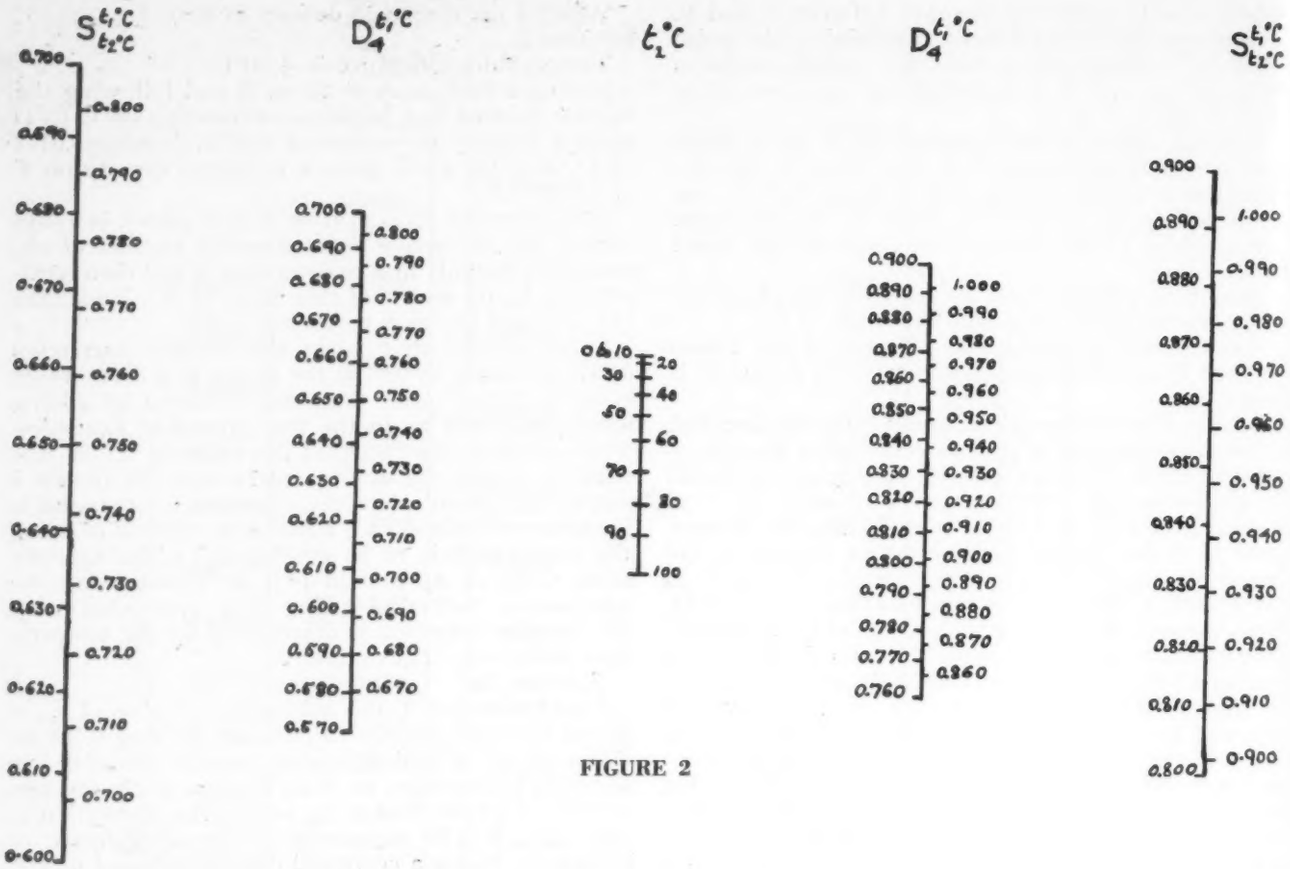


FIGURE 2

value of 0.6870 at 20, by splitting the temperature difference into two equal parts and doubling the value of the density correction on D, thus:

Temperature difference = 2(—35)°C. Joining 0.687 on A to 35 on B, and following the nearest parallel line between intersection on C to D gives a density correction of 0.0316. Doubling this correction gives 0.0632, which is to be subtracted from the corrected density value at 20°C., 0.6870, to give the corrected density value at 90°C. of 0.6238 as compared with the value, obtained by accurate calculation, of 0.6240.

By means of the steps shown in solutions 4a and 4b, the range of the nomograph is thus extended for calculating the densities of American petroleum oils, provided the observed temperature of the density measurement is between —20° and 60°C. In brief, from the observed density at t, the corrected density at 20°C. is determined approximately from the nomograph. Using the approximate value of ρ_{20} as a basis on A the density correction for $(t_1 - t_2)$ is determined and this is either added to or subtracted from the density at t_1, as the case may require. Alternatively, the accurate value of ρ_{20} is determined first by means of the method adopted in solution 3a. The density correction is then determined not for $(t_1 - t_2)$ but for $(20 - t_2)$ and added to or subtracted from ρ_{20}. If $(20 - t_2)$ exceeds 40°C. then the density correction is found for half the interval and doubled subsequently before the addition or subtraction is performed.

These remarks are made on the following assumptions (a) throughout the temperature range covered by the use of the nomograph, the densities of the oils are between 0.620 and 0.965; (b) on lowering the temperature no solid phase, wax, etc., separates; (c) the oil has the characteristics indicated by the "American Petroleum Oils" which form the bases of this discussion; (d) $t_1 - t_2$ does not exceed 100°C.

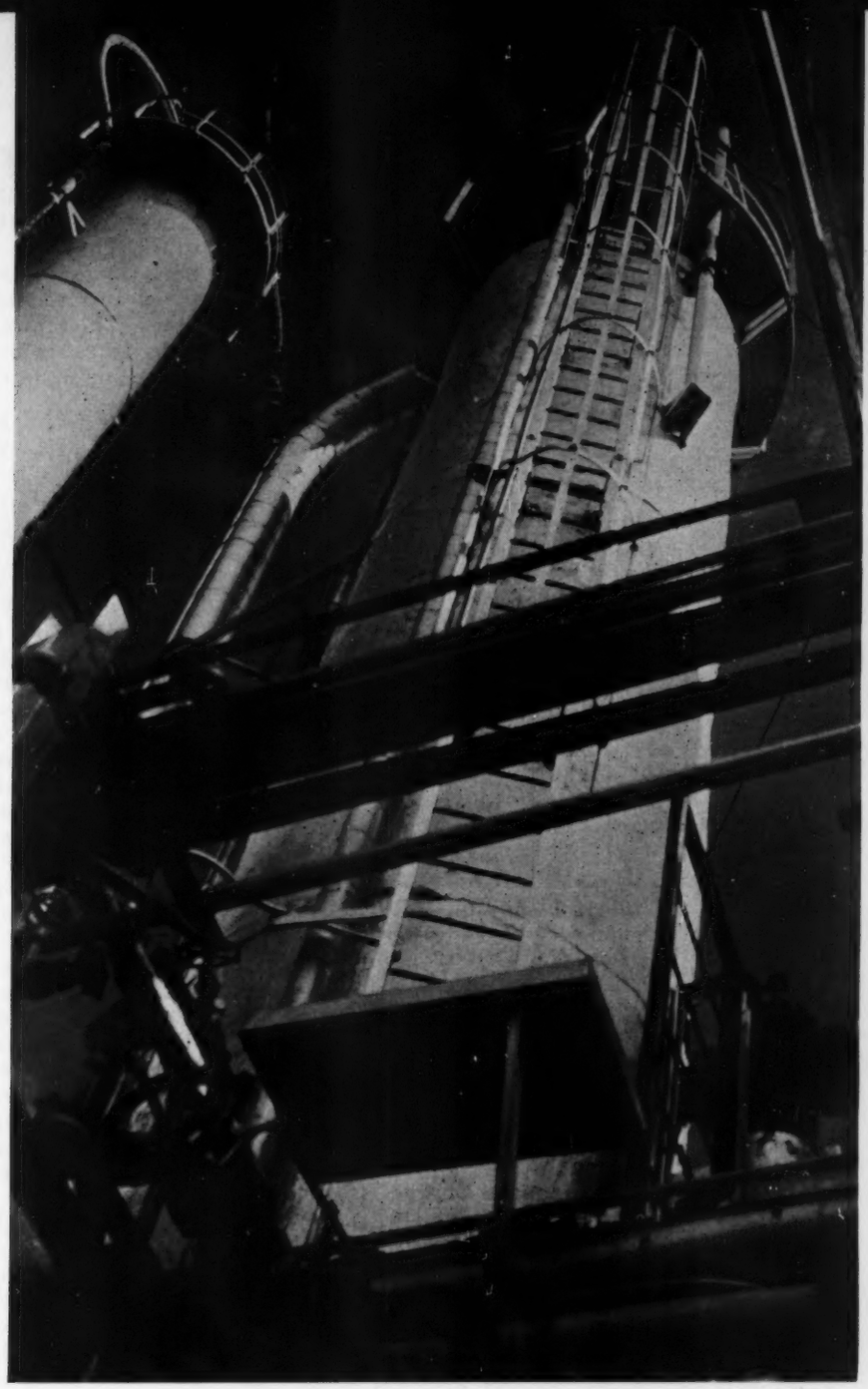
Finally, to extend the use of the nomograph to specific gravity calculations, the following table may be used.[3] The corrections are expressed as units in the fourth decimal place, and are to be subtracted from the specific gravity, $S^{t°c/t°c}$, in order to obtain the corresponding density in gms./ml. at t°c, ρ_t. Interpolations may be used.

Sp. Gr.	$S_{0°/0°C.}$	$S_{15.5°/15.5°C.}$	$S_{25°/25°C.}$	$S_{38°/38°C.}$
0.6	1	6	18	42
0.7	1	7	20	49
0.8	1	8	23	56
0.9	1	9	26	63
1.0	1	10	29	70

For work involving only 3 decimal places the nomograph in Figure 2 may be used to convert $S^{t_1°c}_{t_2°c}$, the specific gravity at t_1°C taken with reference to water at t_2°C to $D_4^{t_1°c}$, the density in gms./ml. between the values of specific gravity of 0.600 to 1.000. A straight line joining t_2°C to $S^{t_1}_{t_2}$ intersects the $D_4^{t_1}$ line at the value of density required. Similarly, a line joining $D_4^{t_1}$ to t_2 yields $S^{t_1}_{t_2}$. When $t_1 = t_2$, the value of the specific gravity will be $S^{t_1}_{t_1}$ and values of t_1 will be used on the temperature axis. To change $S^{t_1}_{t_2}$ to $S^{t_1}_{t_3}$, a straight line joining the values of $S^{t_1}_{t_2}$ and t_2 will yield $D_4^{t_1}$ on the density line. A second straight line joining this value of $D_4^{t_1}$ on the density line and t_3 on the temperature axis will intersect the specific gravity axis at the value of $S^{t_1}_{t_3}$.

REFERENCES

[1] V. Stott, *J. Inst. Pet.*, **26**, 235, (1940).
[2] E. S. L. Beale, *J. Inst. Pet.*, **23**, 213, (1937).
[3] H. Abraham, "Asphalts and Allied Substances," p. 791 (4th edition 1938).



Combination Charging Stock Yields High Octane and Extended Run

THROUGH an uninterrupted run of 2561 hours with a Universal Oil Products Company cracking plant from April 20 to August 5, 1941, inclusive, Mid-West Refineries, Inc., Alma, Michigan, obtained an overall liquid yield of 94.45 percent. In this yield was 60.85 percent overhead distillate which was fractionated to an end point of 395° F., having a gravity of 61.7° API. The octane value of this product was 68, research method, which, with the addition on 1 cc. TEL, was raised to an octane value of 75.5. The charge to the fractionating tower during this 106-day run consisted of a mixture of reduced crude and fresh crude.

This plant was built as a straight skimming plant. A single furnace Dubbs cracking unit built in 1939 had a capacity of 1000 barrels per day, to operate as a full flashing, selective cracking unit. In 1940, the plant was increased to its present capacity of

Summary of 2561-Hour Run of Mid-West Refining Company, at Alma, Michigan

	Percent	Barrels
Total Charge to Cracking Unit	100.00	233,013
Raw Topped Crude	56.39	131,415
Illinois Crude	36.68	85,373
35 Octane Straight Run Gasoline	6.93	16,225
	100.00	233,013
Yields, liquid recovery	94.45	220,090
Overhead Distillate 61.5° API, 68 octane	60.85	141,809
Side-cut Distillate	.69	1,605
Residuum	32.91	76,676
	94.45	220,090
Gas and Loss	5.55	12,923
	100.00	233,013

Distillation and Tests

	Raw Oil	L. O.	S. R. Gaso.	Resid.	H. O.	Ill. Crude	Finished Gaso.
IBP	550° F.	225° F.	100° F.	410° F.	330° F.	138° F.	100° F.
10 Percent	.....	412	.....	.....	.....	243	140
20 Percent	.....	435	.....	.....	.....	311	172
30 Percent	.....	450	.....	.....	.....	387	202
40 Percent	.....	458	.....	.....	.....	.....	228
50 Percent	.....	468	.....	.....	.....	.....	252
60 Percent	.....	477	.....	.....	.....	.....	274
70 Percent	.....	488	.....	.....	.....	.....	307
80 Percent	.....	503	.....	.....	.....	.....	340
90 Percent	.....	530	.....	.....	.....	.....	384
EP	.....	576	342	.....	.....	.....	394
API°	24.5	30.0	65.0	7.8	20.3	37.2	61.7
Octane	.....	35.0	.....	.....	.....	.....	68.0
NaCl	4#	.....	.....	.....	.....	30#	.....
BS&W	0.3%	.....	.....	0.5%	.....	0.3%	.....

Furnace Temperatures

	H.O. No. 1	H.O. No. 2	L.O.	Reform.
Inlet	727° F.	727° F.	550° F.	80° F.
Shock	827° F.	822° F.	965° F.	998° F.
Transfer	927° F.	927° F.	1015° F.	1006° F.

2000 barrels by adding a second furnace and the necessary pumps and instruments for adequate operation and control.

Cracking Furnace Charge

Operation of this plant includes facilities for using the left side of each heater for processing the heavy oil charge from the fractionator base. The right side of the older heater is used for handling the light oil charge from the accumulator pan in the fractionator, and the right side of the new heater is arranged to reform a 35-octane straight-run gasoline. Four separate charging pumps are employed to deliver charges to the heaters, two being used for the heavy oil, one for the light oil and one for the straight-run gasoline. The three hot oil pumps are each operated with separate Diesel engines, but the gasoline charge pump is a duplex, outside plunger packed steam pump.

The heavy oil side of both heaters contain 92 tubes each of 2⅝-inch OD x 2⅛-inch ID, 22-foot tubes. The light oil section of the older furnace contains 33 tubes in the convection section, five shock tubes and a double row on the wall containing 62 tubes. The straight-run side of the new furnace contains 16 tubes in the convection section, four in the shock and 62 in the double row on the wall.

Fractionator Charge

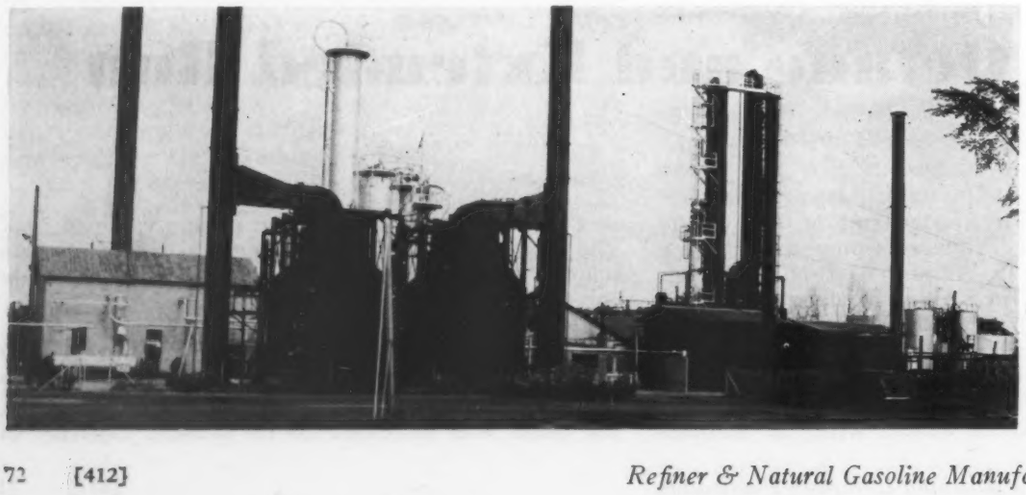
The transfer lines from both heavy oil sections join at the inlet nozzle of the reaction chamber but both the light oil and reformed straight-run lines are connected to the inlet nozzle of the flash chamber.

Topped crude from the skimming plant storage tanks is picked up with a duplex steam pump and the fresh crude blended with the fractionator charge in the delivery line before the mixture enters the column on the eighteenth side-to-side pan below the light oil accumulator section. The heavy hot oil is removed from the base of the main column by a line which splits the stream to the suction of both heavy oil hot oil pumps. Each heavy oil pump is a duplex, outside packed double plunger power unit operated by individual Diesel engines. Each heavy oil pump handled 2852 barrels per day, which totaled 5704 barrels of heavy oil to both furnaces, resulting in a recycle ratio to the combined feed of 4:1.

Light oil is introduced into the right side of the older furnace at a rate of 1490 barrels per day with a duplex outside end packed double plunger pump, driven by a Diesel engine. The straight-run gasoline is pumped at the rate of 400 barrels per day with a duplex outside end packed double plunger steam pump. The gasoline to the reforming furnace is held at a pump pressure of 580 psi and the outlet of the furnace is maintained at 525 psi. The transfer temperature on the reforming material is held at 1006° F.

The material from both heavy oil heaters flows in the conventional manner through the reaction chamber to the flash chamber. The blending of the processed light oil and reformed material with the product from the reaction chamber is obtained in a cross tee connection, outside the flash chamber. Quenching of the heavy oil is done at the conventional point in the process, but the light oil and the reformed stock are quenched at the pressure reducing valve at the inlet of the transfer line leading to the flash chamber.

The overhead from the main fractionating column represents the result from cracking heavy oil, light oil and reforming straight-run gasoline.



Cracking furnaces, left, and skimming plant, right.

Qualified Welding in Refining

WELDON L. ARCHER

WITH welding processes becoming ever more important in the construction and maintenance work around a refinery many executives and junior executives are coming face to face with the need for qualifying welding processes and welding operators. Trained as these men are in refining technology they find new and unusual problems before the actual welding work is started.

Today, welding is performed in conformance with established rules which are not as confusing as the laws evolved for playing the game of cricket even though they may seem so at the first glance. Since many state laws demand welding in agreement with the standards established by the ASME code, familiarity with this procedure is indicated. However much work is being completed under the regulations of the API-ASME code. Furthermore there is a perfectly good standard qualification procedure that has been developed by the American Welding Society. Here in the space of one paragraph have been introduced three different sets of rules for playing the same game. No wonder many engineers are afraid to tackle welding problems. But underlying all this surface disagreement is a basic plan employed by all code-writing bodies. Some day all regulatory societies will see the wisdom of adopting the AWS procedure for all welding activities.

Two main thoughts form the foundation for qualified welding. First, there must be a detailed procedure for the work; and, second, the welder must be able to follow the given procedure to produce a perfect weld. That's all there is to it.

The procedure is exactly like a blueprint developed by an architect for a house. This blueprint together with the accompanying detailed specifications enable both the architect and the contractor to visualize the completed home on paper. Blueprint and specifications combine to form the procedure for building the house.

But the mere existence of a house building procedure does not guarantee the completion of a satisfactory dwelling just as the writing of a welding procedure cannot assure the making of a perfect weld. In addition there must be the integrity of the manufacturer or welding contractor or refinery welding supervisor supplemented by skilled workmen. In the case of the house these workmen are carpenters, electricians, plumbers, plasterers, all of whom ply their trades with enough ability to bring about a well built home that satisfies all of the rules formed by the architect. In the case of welding, welders follow their trade to transform the written procedure into a sound weld.

At this point all of the details of the procedure will be enumerated and explained. It is hoped that anyone can follow this explanation as a guide to the writing of an individual procedure specification to suit the needs of the refinery while at the same time satisfying the demands of state laws.

Process

Although there are ten basic welding processes, only two enjoy a wide popularity in refinery welding activities. These are the arc welding process, or to be more exact: the metallic arc process, and the oxyacetylene process. Therefore under the heading of process should be stated the fact that *all welding will be done by the . . . process,* with the blank to be filled with the name of the process you prefer.

Base Metal

For the purposes of this discussion the base metal will be confined to steel. But what kind of steel? There are different varieties all of which are weldable. Sometimes chemical analysis is important. Other times strength is the prime factor. The best plan is to use an ASTM designation which covers chemical analysis and physical properties in a manner that satisfies both the producer and the consumer of the steel. The supplier of quality steel materials is able to suggest an ASTM number that is readily available in addition to supplying the properties desired for the welding application involved. This plan is far better than attempting to pick an ASTM designation out of the book as many steels possess limited availability these days. Thus the second item in the procedure is the listing of the base metal to be welded as *the base metal shall conform to the specifications for ASTM . . .* , again the blank is to be filled with the proper number.

Filler Metal

Until recently specifications for filler metal were sketchy. Unless the user wanted to rely upon brand names he had little opportunity to generalize in his definition of allowable filler metal. Now the AWS-ASTM joint specification for filler metal classifies welding rods and welding electrodes into general groups based upon position of welding, type of welding and resulting physical properties. Following this orderly arrangement anyone, aided by his dealer in welding supplies, can choose the filler metal best fitted for solving his problems. Or a later article in this series may be used to furnish the answer. And in this fashion the third point in the welding procedure sheet becomes *the filler metal shall conform to Classification Number . . . of AWS-ASTM Specification for Filler Metal A233-40T,* with the blank containing the right number.

Position

The welding shall be done in the . . . position. Filling in that blank calls for some further discussion. Welding may be done in a number of positions such as flat, horizontal, vertical and overhead in plate work. In pipe welding the positions are different, being known as horizontal rolling, horizontal fixed and

vertical fixed. In the flat position and in the horizontal rolling position all of the welding is done in a position where the fluid metal is not disturbed by gravitational influences. All the other welding positions are opposed to natural gravitational forces and require additional skill for this reason. Each position demands another type and degree of skill which explains the need for designating the position in which the work is to be done.

Preparation of Base Material

Since welding deals with the application of molten metal, it is frequently advisable to prepare a groove in which this melt may be deposited. How wide should this groove be? How deep? What slope should the sidewalls possess? Is a gap needed? How much? Nor are these all the questions that might be asked. In another article the question of joint design will be given a comprehensive treatment. But for the present we must know that the groove needs to be specified along with the method of its preparation in a sketch or series of sketches. In the following sentence which treats of this aspect of the procedure sheet the blank is to be filled with the applicable word, shearing, machining, grinding, gas cutting, as *the edges or surfaces of the parts to be joined by welding shall be prepared by . . . as shown on the attached sketches and shall be cleaned of all oil or grease and excessive amounts of scale or rust, except a thin coat of linseed oil, if present, need not be removed.*

Nature of Electric Current

The current used shall be direct or alternating. That statement cannot be used notwithstanding the fact that there are electrodes on the market that may be used equally well with either type of current. So insert one or the other. If direct current is selected, it is necessary to designate the polarity as well. Should alternating current be desired, the frequency of the current must be stated. This applies to metallic arc welding only.

Size of Welding Tip

The range in size of welding tips used shall be as shown on the attached sketch. This is the same sketch that was mentioned before or it may be a separate sketch. The range of sizes shown should encompass the whole group of thicknesses to be welded.

Nature of Flame

The flame used for welding shall be . . . , here the word "neutral" or the words "excess acetylene" must be inserted depending upon the practice followed.

Method of Welding

The method of welding shall be that known as . . . , either "backhand" where the welding is done in the opposite direction to that in which the flame is pointing or "forehand" where the welding is done in the same direction in which the flame is pointing must be inserted here. The three paragraphs above apply to oxyacetylene welding only.

Welding Technique

This subject will be divided into two paragraphs under the same heading with one being devoted to metallic arc problems while the other deals with gas welding details. For metallic arc welding the welding technique, electrode sizes, and mean voltages and currents shall be substantially as shown on the attached sketches. The original sketches or new ones may be used. Or an appearance weld in which sections of the weld in various stages of completion are shown photographically may be used. As this scheme allows a little more flexibility, many procedure sheets use it in preference to the more detailed specifications in the statement above.

For oxyacetylene welding the size of rod and the number of layers used for welding the various base metal thicknesses shall be as shown on the attached sketches. Sketches and tables of explanation may be identical with those required for the base metal preparation.

Cleaning

All slag or flux remaining on any layer of welding shall be removed before laying down the next successive layer.

Defects

Any cracks or blow-holes that appear on the surface of any layer of welding shall be removed by chipping, grinding, or gas gouging before depositing the next successive layer of welding. At this point it seems appropriate to mention that good techniques and good equipment in the hands of able welders will produce

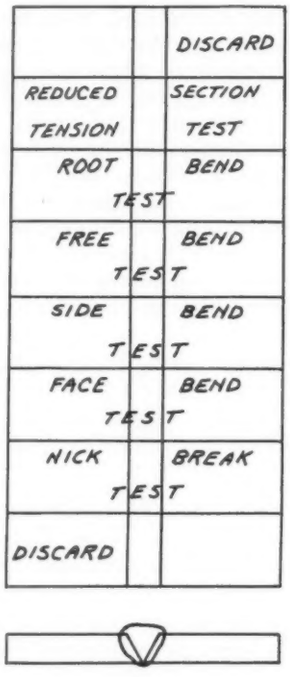


FIGURE 1
Test weld for plate

welds without cracks or blow-holes. The presence of such imperfections indicates the need for immediate investigation into the cause of the trouble.

Peening

If peening is used, and it is oftentimes to reduce shrinkage stresses and to increase the strength of the joint, the amount of peening should be stated. *Peening should be . . .* Light, medium or heavy may be inserted in the blank depending upon the practice adopted.

Treatment of Under Side of Welding Groove

Where double butt welding is specified, a statement about the treatment of the under, or second, side of the welding groove is in order. This may well be *the*

under, or second, side of the welding groove shall be chipped, ground or flame gouged to sound metal before being welded.

Preheating

Preheating to a temperature of ...° F. shall precede all deposition of weld metal. Some alloy steels need to

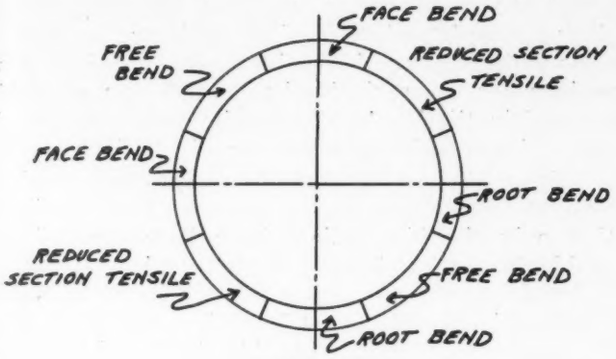


FIGURE 2
Test weld for pipe

be preheated to avoid cracking troubles. In this case the statement above and the temperature should be given. This information can be secured from the steel producer.

Heat Treatment

After welding the joints shall be stress relieved in accordance with the requirements of the . . . code. Either the API-ASME or the ASME letters are needed here depending upon which code is being followed for the work.

This procedure specification has been outlined most completely. By picking out the paragraph headings that apply, only those on peening, treatment of the under side of the welding groove, preheating and heat treatment may not, the refinery engineer may fill in the blanks in the italicized statements to end up with a complete working specification that will be acceptable to code and state authorities.

With everything detailed the next step is the accomplishment of a sample weld. For this specification is acceptable only if it is followed to a successful completion in the physical testing of a test plate

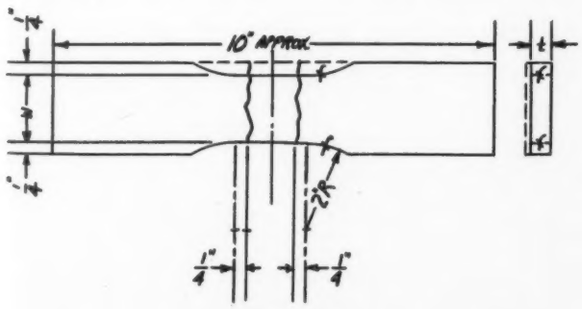


FIGURE 3
Reduced section tension test

welded in strict accordance with the outlined procedure. In other words the recipe must be tested before it is approved.

The test plates cover the thickness to be welded as well as the welding position. To understand the principles underlying the test plates for checking the welding procedure it is worthwhile to study a typical test plate for plate or pipe welding as shown in Figures 1 and 2 respectively. While regarding the test plates along with their respective specimens, the differences between procedure test plates and operator test plates may be noted.

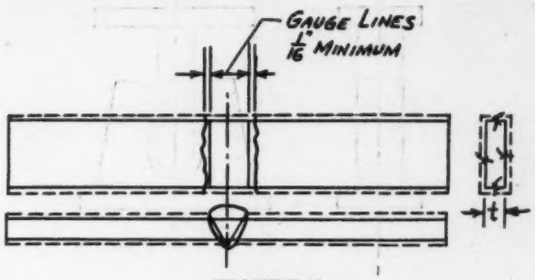


FIGURE 4
Free or face bend test

Procedure test plates are very thorough going into matters of tensile strengths and per cent of elongation. In this comprehensive test program all of the important physical attributes of a sound weld are explored. But the testing of a welder is much more simple. Since the procedure has already typed the properties of a good weld, all that is required of an operator is to make a good weld. The strength and ductility of a sound weld having been established by a test of the procedure it follows that the operator who makes a sound weld must have produced one with the demonstrated properties.

Tests Required

Therefore the procedure qualification considers the reduced section tension test, the free bend test, the root bend test, the face bend test, and the side bend test. The operator qualification test is restricted to the root, face and side bends all of which determine soundness and fusion characteristics without paying any attention at all to tensile strength or percent of elongation. In any event tests in the ⅜-inch and 1-inch thicknesses will suffice for the welding of any thickness of material.

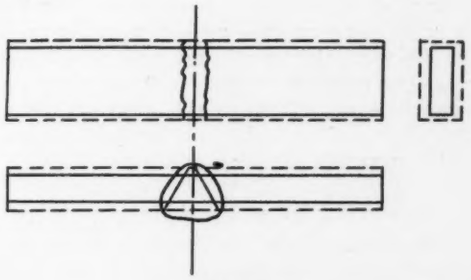


FIGURE 5
Root bend test

In the following paragraphs each of these tests will be discussed. Since the tests peculiar to qualifying the procedure are the tension test (reduced section) and the free bend test, these will be understood to apply to the procedure qualification alone. Furthermore in view of the fact that at least one code body recognizes the nick break test, this specimen will be mentioned too.

Reduced Section Tension Test

In Figure 3 is illustrated the reduced section tension test specimen. The dimensions are supposed

to be selected in an effort to force the break to occur in the weld. As a matter of fact most of the fractures take place outside the weld proving that the weld is stronger than the plate material it joins. The minimum requirement for the strength of the joint

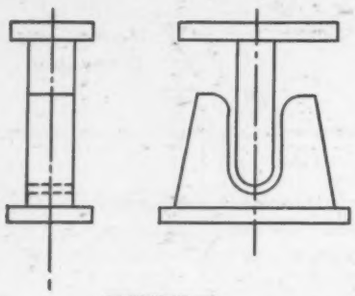


FIGURE 6
Guided-bend test jig

is at least 100 percent of the strength of the plate. For all but rather poor welds the meeting of this requirement is most easy.

Free Bend Test

The free bend test, shown in Figure 4, gives an indication of the ductility of the weld. The minimum requirements of 30 percent for stress-relieved welds and 25 percent for unstress-relieved welds are readily exceeded by all sound welds. As a matter of fact both this test and the reduced section tension test have as the only excuse for their existence in this day of advanced welding development their utility as a trap to catch the unskilled welder and the poor welding procedure. Neither an able welder nor a fairly good procedure meets with any trouble in satisfying the mild demands of the present day codes.

Root and Face Bends

The root bend of Figure 5 and the face bend which is prepared just like the free bend of Figure 4 are designed for test in the jib shown in Figure 6. These are tests for soundness which must bend to the contour of the jib without exhibiting any defect greater than ⅛-inch in any dimension after bending. This excludes any cracks which may have formed in the corners of the specimen and which have no bearing on the quality of the weld. In the root bend the bottom or root of the weld is placed in tension while in the face bend the top or face of the weld is the tension surface.

Side Bend

The side bend is similar to and must meet the same requirements as the root and face bends. In this specimen, as the name suggests, the side of the weld is put in tension in the jig. Here, too, soundness of the weld and quality of fusion are tested.

Nick Break Test

Figure 7 illustrates the nick break test which must be broken by a sharp blow or by sharp blows to reveal the soundness of the weld. This test must show a complete absence of all oxide or slag inclusions with a degree of porosity not to exceed six gas pockets per square inch of the total area of weld exposed in the break. The maximum dimension of any such gas pocket may not exceed 1/16 inch.

This article has been presented as a tourist guide to qualified welding in the refinery. It is obvious that only the high points have been covered to enable the tourist planning to visit the land of qualified welding an opportunity to see what lies ahead. The individual codes must be reviewed to fill in the skeleton with the flesh and blood of the problem. This work should be easier as a result of getting a view of the basic ideas underlying the program of qualified welding.

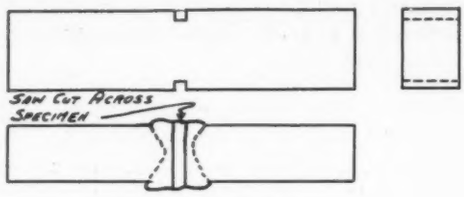


FIGURE 7
Nick break test

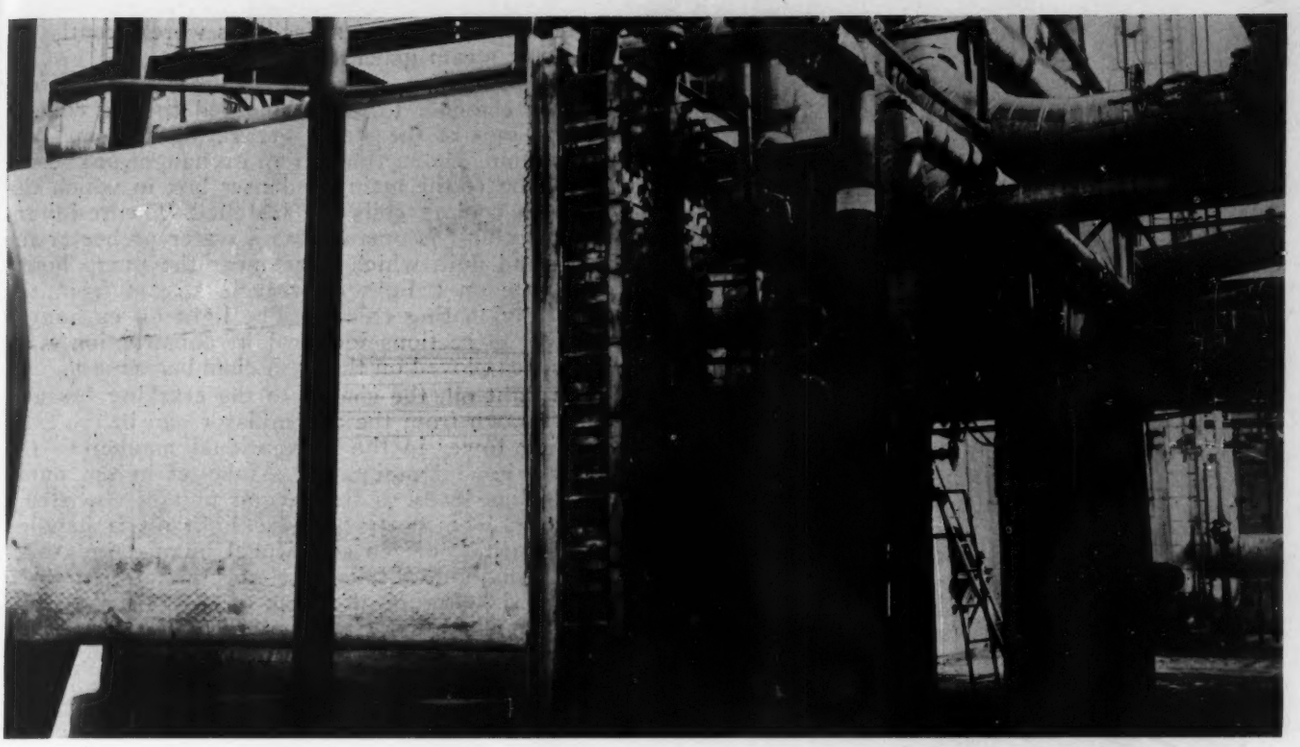
Many excellent welding products used with the fine steels developed for welding should enable anyone to meet the requirements of code welding. Proficient operators are the soldiers who can execute the commands of the specifications. The standards are quite reasonable once they are understood. Of course there are questions of joint design for welding, selection of electrodes for metallic arc welding and the actual execution of the weld remaining. But these call for rather detailed treatment and will be held over for following articles in this same series.

Bibliography

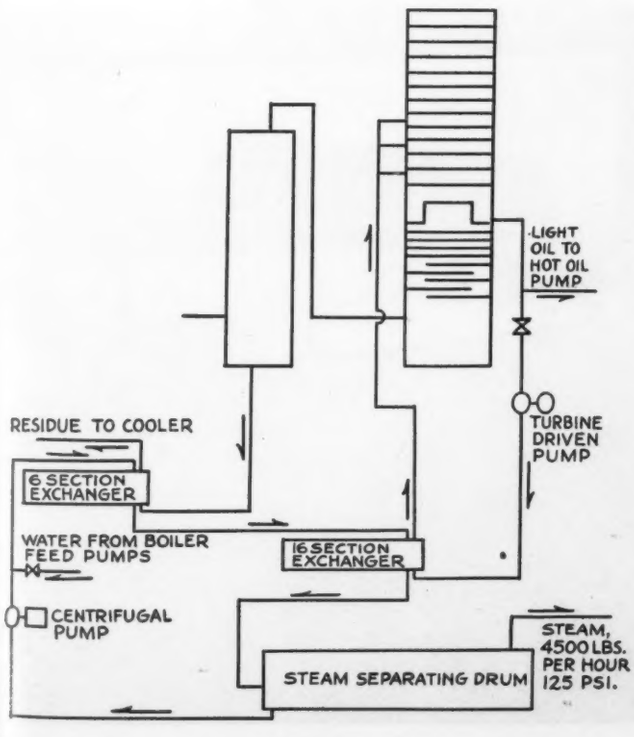
Standard Qualification Procedure, The Welding Journal, July, 1941, page 448 et seq.

API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases.

ASME Code for Unfired Pressure Vessels.



Steam Generating Unit Also Improves Fractionation and Condensation



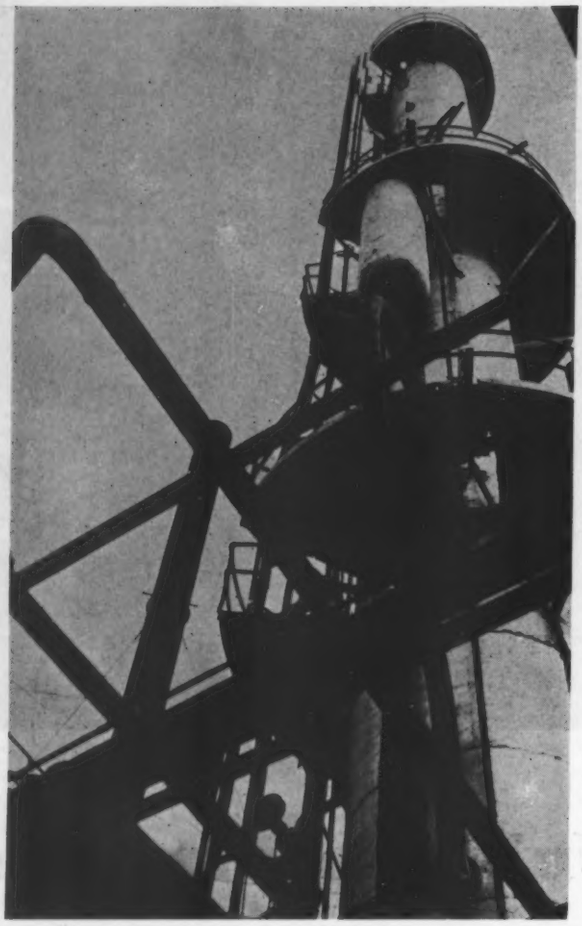
BY installing equipment for generating steam by heat exchange with streams from the flash chamber and the main fractionating column Naph-Sol Refining Company, Muskegon, Michigan, has augmented its boiler feed as well as improved operation of the fractionating column. Before being returned to the column for reflux the light oil stream operates in steam generation with the result that a smaller quantity is required for maintaining the proper top temperature for the column. The heat reduction in the residuum stream from the flash chamber is reduced by 300° F. in its heat exchange with the result that less water is used for condensation.

The steam generating unit produces an average of 4500 pounds of steam per hour at 125 pounds per square inch.

Residuum from the flash chamber is withdrawn at 805° F., which in conventional operation is water cooled to required storage temperature. In the main fractionating chamber, the light oil stream has a temperature of 560° F. Taking advantage of the tem-

Left is a flow diagram of the arrangement of units for generating steam by taking advantage of heat from stream of two vessels in the plant of the Naph-Sol Refining Company, Muskegon, Michigan.

The picture at the top of the page is a 16-section heat exchanger on the light oil stream.



Above is the line returning to the fractionating column when using a split stream of light oil, which provides intermediate column reflux and better tower control.

Below is the receiver for steam and condensate.

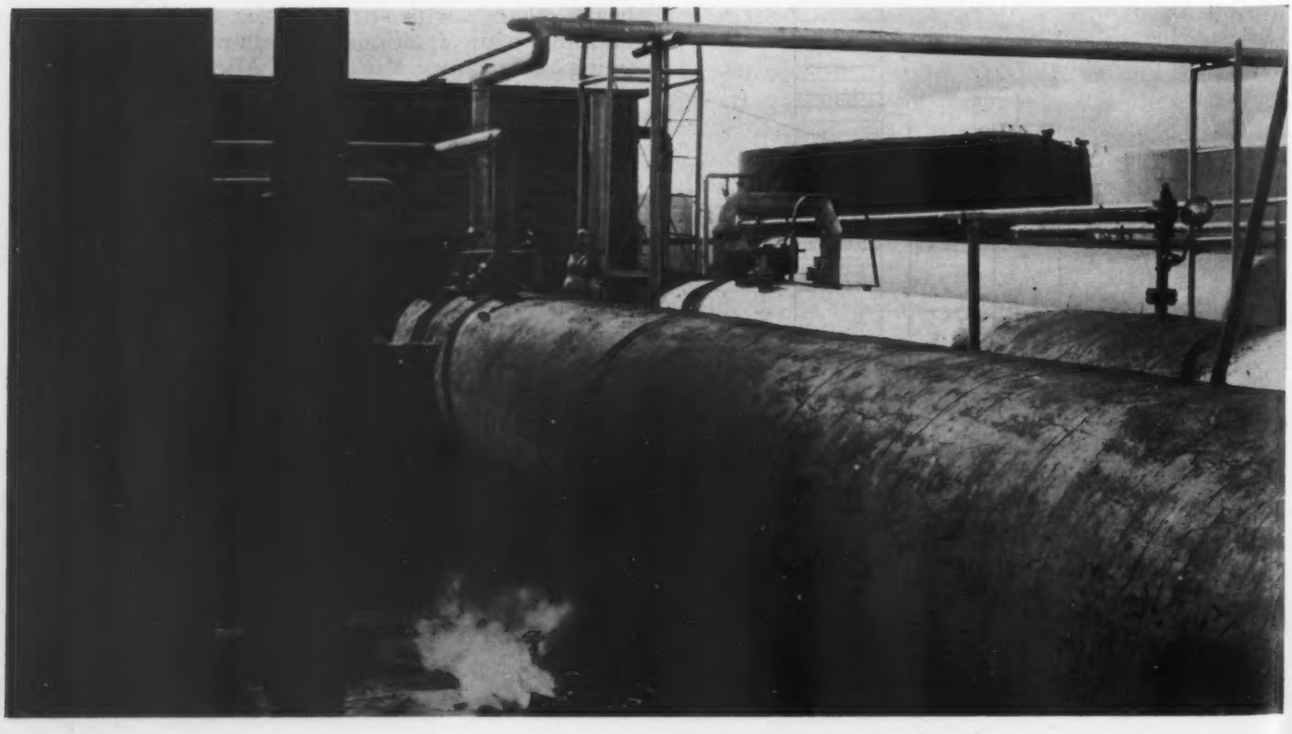
perature of both streams, facilities were recently installed for steam generation.

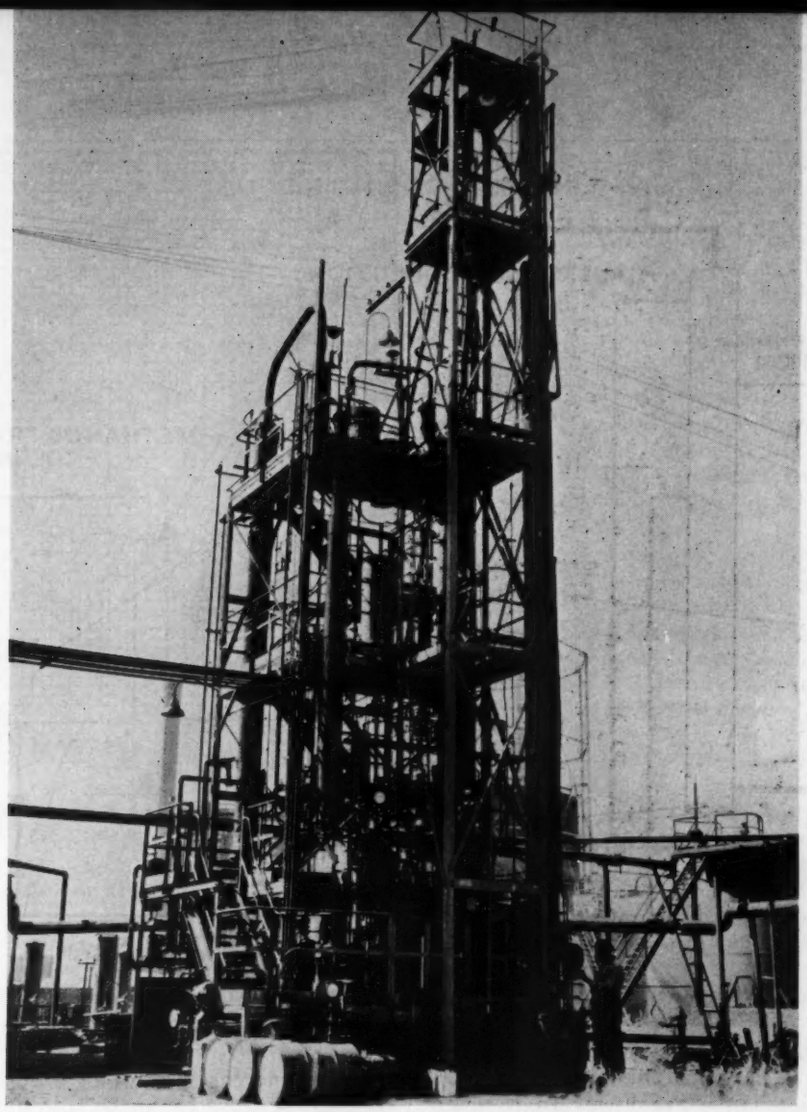
Manifolded into the residuum draw-off line from the flash chamber to the submerged cooling coils is the first unit of the steam generating system. This unit contains six sections in an exchanger set beside the section of the main condenser box in which the residuum cooling coils are installed. The residuum exchanger unit is operated as a water preheater for the second unit, which is set near the pump house to operate on a light oil recycle stream from the main fractionating column. The light oil exchanger contains 16 sections identical in construction with the unit employed on the flash chamber stream.

The light oil, the charge to the cracking furnace, is withdrawn from the accumulator pan in the fractionating tower in the conventional manner to the light oil hot oil pump, but a take-off in the pump suction line leads to the second unit of the steam generator. This portion of the light oil is handled with a turbine driven centrifugal pump taking suction on the light oil take-off connection and pumping the material through the bank of 16 exchangers and returning it to the fractionating plates above the light oil accumulator section in the main fractionating tower.

The steam side of the generating system includes a horizontal steam drum where generated steam is collected and water residue from the system is separated. A motor driven centrifugal pump takes suction on the lower side of the steam drum to return condensate to the generating system. Make-up water is supplied from the main boiler plant, after treatment to zero hardness so that scale will not be deposited in the exchangers.

Make-up water comes into the steam generating system from the discharge of the regular boiler feed pumps, between the discharge of these units and the boiler water level controllers, in a quantity sufficient to maintain a predetermined water level in the steam collecting drum. The steam at 125 psi is introduced into the plant steam system.





Caustic-Methanol Pilot Plant

Caustic-Methanol Mercaptan Extraction Process

H. W. FIELD
The Atlantic Refining Company

A RADICALLY new refining process, developed by the Atlantic Refining Company, removes mercaptans from gasoline and substantially improves its lead susceptibility. Octane rating suffers no loss in any gasoline treated by this process and in many gasolines is increased.

Mercaptan removal is brought about by extraction with an aqueous solution of caustic soda and methanol. The caustic is continuously regenerated and the methanol almost entirely recovered. The process is based on existing patents* and a considerable number of recent applications.

The tetraethyl lead saving caused by the elimination of octane loss, and the increase in lead susceptibility produced by caustic-methanol extraction, will usually pay all costs of operating the process and in some instances yield a profit.

Sweetening by older methods was in most instances a necessary charge which had to be borne. The cost might be high or low according to the carefulness with which the procedure was carried out, but even under the best conditions the sweetening methods did not improve the gasoline in octane rating, lead susceptibility, or any other property except odor.

The employment of caustic washing units with regeneration was an advance in refining procedure as compared with sweetening alone. Caustic washing in many gasolines produces a substantial increase in lead susceptibility, but usually caustic washing will only partially sweeten gasoline and a substantial proportion of the mercaptans, probably the higher boiling ones and those with branched chains, remain in the oil. These remaining mercaptans prevent the full possible gain in lead susceptibility from being achieved and necessitate subsequent sweetening to produce a marketable product.

One Unit Required

The Caustic-Methanol Process in a single operation gives a finished gasoline of sweet odor and almost

* U. S. 1,968,842 and 1,968,843 (1934); 2,043,254 (June 9, 1936).

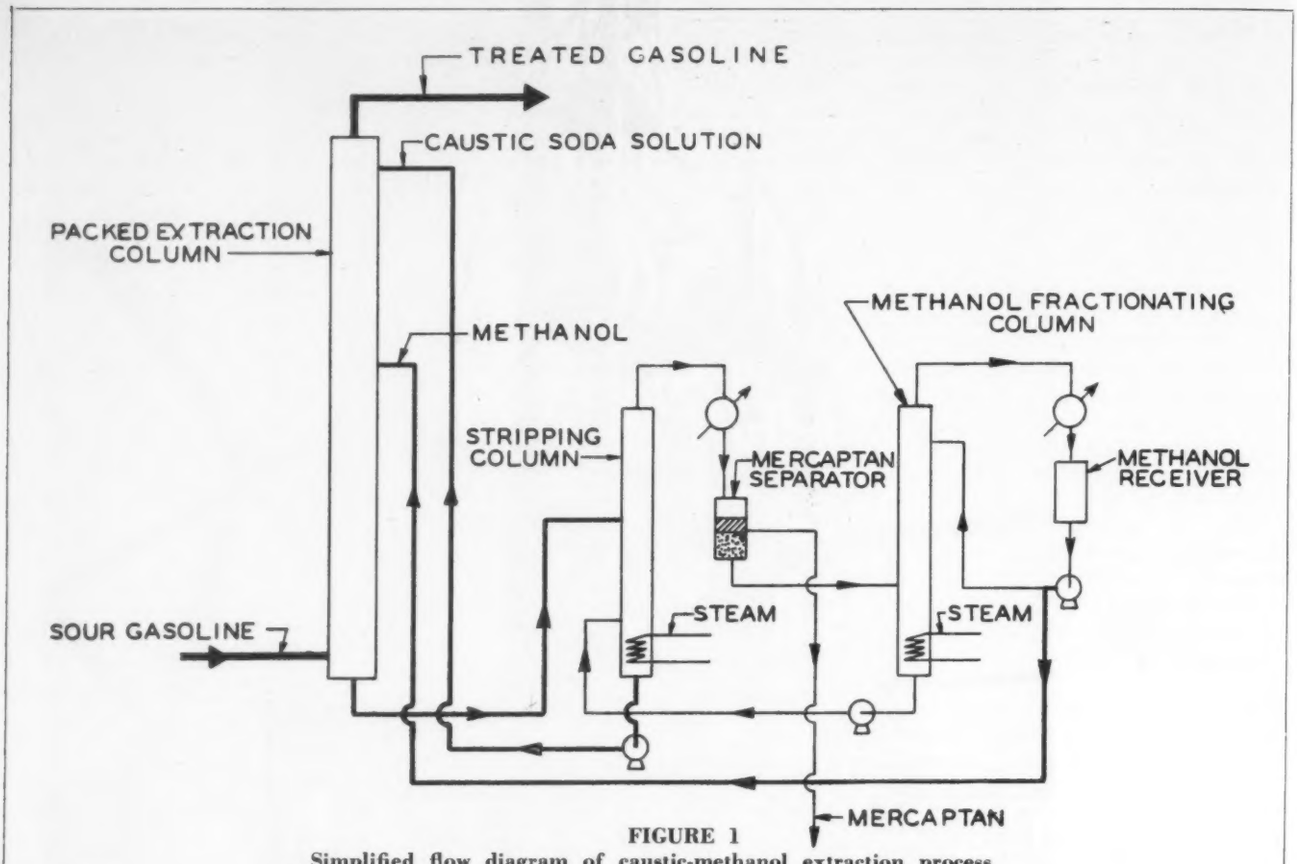


FIGURE 1
Simplified flow diagram of caustic-methanol extraction process

undetectable mercaptan content. Since only one plant is required, installation costs are lower than when both a caustic washer and a sweetening plant are required.

Operating costs also are low because caustic soda and methanol are comparatively cheap chemicals, the volume of reagent used is small in proportion to the gasoline treated, and the chemicals are almost completely recovered. In fact, the operating costs are comparable to those of operating a simple regenerative caustic scrubber.

Advantage can be taken of the higher finished octane and lower sulphur content obtainable by caustic-methanol extraction in any of three ways:

1. By using less tetraethyl lead and selling a product of the same quality as before installation of the process.

2. By using approximately the same amount of lead and selling a better product.

3. By using a higher proportion of sour crudes.

If a product of the same octane rating as before the installation of caustic-methanol treating is marketed, the lead savings are substantial. Few gasolines will show a saving of less than 0.25 cc. tetraethyl lead per gallon, while in some the savings run to as high as 1.0 cc.

The octane increase which the new process makes possible allows many refiners to bring their gasoline up into octane brackets not previously attainable. Some cracked gasolines, which, treated by older methods cannot be leaded to the octane rating demanded for regular grade, can be brought to that level when caustic-methanol refining is employed and some can be economically raised to the ethyl standard. The increased value of the gasoline may be substantial, because it can be sold as a higher quality.

Many refining plants have reached the practicable limit of octane rating obtainable by leading, and are faced with the necessity of installing new processes, involving costly construction, in order to meet mounting octane requirements.

The Caustic-Methanol Process will relieve some of this need for new plant construction. This is an important consideration at any time, but particularly so during the present emergency, when materials for plant construction and labor are difficult to obtain.

Description of Flow

Figure 1 is a simplified flow diagram of the Caustic-Methanol Process. A hydrogen sulfide free gasoline is charged to the base of a tall countercurrent extraction column, packed with Raschig rings. Methanol is introduced in the middle of the column and a concentrated aqueous solution of caustic soda is fed in near the top. The column is operated in the conventional manner, the gasoline passing upward and disengaging cleanly at the top. The caustic-methanol solution is drawn from the base of the extraction column and passed to a stripping column. From the stripper, which is fitted with an internal reboiler, methanol and water pass overhead to collect in a separator in two layers, the upper one mercaptan and the lower water-alcohol, the ratio of water to alcohol being regulated to keep it at the point of minimum solubility of mercaptan. In the stripping column, the caustic is regenerated and thence returned to the extraction column. The methanol-water passes from the separator to a small fractionating column, where the alcohol is taken off overhead and is returned to the extraction

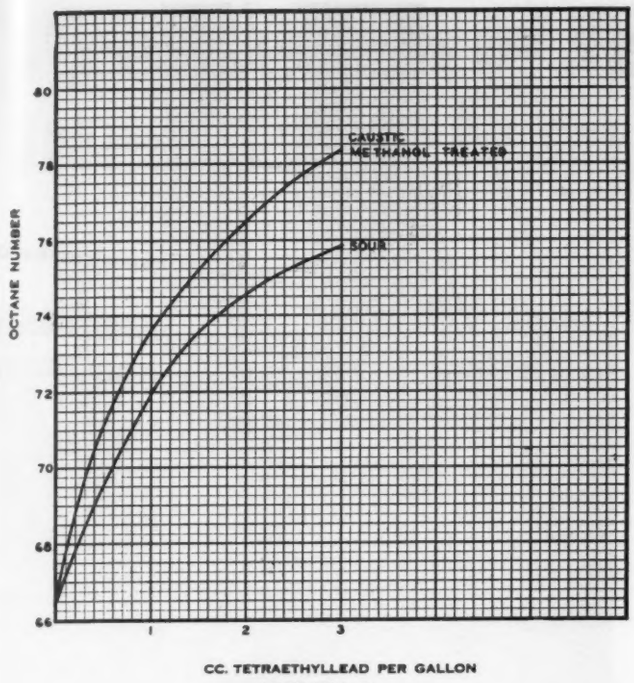


FIGURE 2

Effect of caustic-methanol extraction on lead susceptibility of Michigan cracked gasoline.

column, while the water from the base of the fractionating column returns to the stripping column.

A noteworthy feature of the process is the great holding power for mercaptans of the solution of caustic soda containing methanol. Because of this, a low circulation rate of methanol and caustic is sufficient for effective mercaptan extraction. The combined methanol and caustic solution used usually do not exceed 3 percent of the volume of the gasoline. This low circulation makes it possible to regenerate the caustic with small sized, inexpensive equipment, using only a small amount of steam.

Low operating costs are due to the fact that there is almost no loss of chemicals. Alcohol losses are generally 0.004 percent or less of the volume of the gasoline. Total operating costs on an average gasoline, including utilities, chemicals, labor, maintenance, and insurance will be approximately 1 to 1.5 cents per barrel.

The Caustic-Methanol Process can readily handle gasolines of high phenol (tar acid) content. In the regeneration step, the methanol is distilled away from the caustic layer, leaving phenols and any other contaminants which may have come from the gasoline in the caustic solution. Portions of this solution can be discarded without losing any alcohol and without great cost, as caustic soda is a comparatively cheap reagent.

While it is not advisable to remove phenols from gasoline when they are present in low concentration, some removal is desirable both in the interests of gum elimination and improvement of storage stability when they are present in large amounts.

In most processes employing caustic washing, special preliminary caustic scrubbers must be provided when treating gasolines containing large concentrations of phenols to prevent loss of efficiency of the scrubbing solution by saturation with tar acids and particularly avoiding loss in efficiency of regeneration.

Preliminary scrubbing, except for hydrogen sulfide removal, is unnecessary with caustic-methanol treating. A solution of caustic soda containing methanol is not made less effective for eliminating mercaptans by a high concentration of phenolates. If it is desired to minimize the removal of phenols from the gasoline, they are allowed to concentrate in the scrubbing caustic; if some phenol removal is desired, regenerated caustic ran be removed from the system at a rate that will keep the phenols in the gasoline at the desired concentration. The sodium phenolates may be neutralized and phenols recovered.

Inhibitor response of caustic-methanol treated gasoline is excellent, equal to the best that can be obtained with sweetened gasolines with perfect operation of the treating plants. The uninhibited induction period can be controlled by watching phenol concentration, as just outlined, and a safe increase in induction period and reduction in copper dish gum to an acceptable figure is readily obtained with synthetic inhibitors.

The feasibility of the Caustic-Methanol Process has been proved by ten years' research followed by operation of a pilot plant having a capacity of 100 barrels per day for more than a year. Typical data from both laboratory and pilot plant investigations are shown in Table 1. The results on the Michigan gasoline are also shown graphically in Figure 2.

The gain in leaded octane is substantial in all cases, allowing either savings in tetraethyl lead or improvement in the octane number with the same leading. Figure 2 shows the lead saving possible with a Michigan gasoline. The West Texas cracked gasoline could not be leaded even to regular grade quality without extraction, whereas the extracted product was brought into this bracket. The West Texas cracked-polymer blend reached 80 octane (Ethyl grade) with nearly 1 cc. less lead after extraction than before.

The Caustic-Methanol Process will be licensed by the Universal Oil Products Company.

TABLE 1
Results of Caustic-Methanol Sweetening

GASOLINE TREATED	Mercaptan Sulfur, Percent		Total Sulfur, Percent		OCTANE NUMBERS							
					Before Treating				After Treating			
	Before	After	Before	After	0	1	2	3	0	1	2	3
Laboratory:												
Panhandle Texas	0.061	0.0002	0.15	0.10	63.2	68.3	....	72.2	63.2	69.2	....	73.4
West Texas Cracked	0.18	0.0002	0.77	0.50	66.0	68.8	....	71.4	66.5	70.6	....	74.2
Michigan	0.048	0.0003	0.13	0.10	66.5	72.0	....	75.8	66.5	73.6	....	78.3
Illinois	0.036	0.0002	0.09	0.06	67.1	73.0	....	76.5	67.1	73.8	....	77.8
Pilot Plant:												
West Texas Cracked Polymer Blend	0.0615	0.0007	0.190	0.128	74.0	78.0	80.5	81.5	74.0	80.0	82.2	83.8
Low Sulfur Cracked	0.0226	0.0003	0.092	0.071	71.7	77.3	79.1	80.5	72.0	78.0	80.0	81.3
Straight Run Mixture	0.009	0.0002	0.057	0.049	62.5	70.1	74.7	78.2	64.2	72.1	77.8	80.5
West Texas Straight Run	0.061	0.0003	0.125	0.055	69.8	73.0	76.5	79.0	71.5	78.9	81.7	83.0
High Sulfur Cracked*	0.050	0.0004	0.248	0.182	68.6	72.8	74.9	76.0	68.8	73.6	75.9	77.0

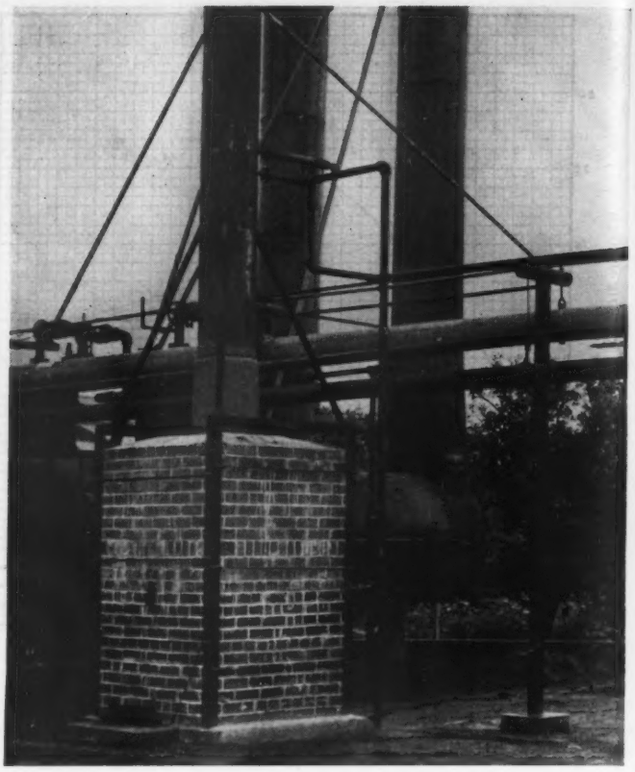
* Approximately 50 percent of mercaptans in this stock previously removed by caustic washing.

Reclaiming Absorption By Vacuum Distillation

O. C. FIELD Gasoline Company reclaims mineral seal absorption oil at Monte Bello, California, by using a direct-fired retort combined with vacuum. Since the split stream from the gasoline still to the absorption-oil reclaiming unit will not vaporize at one pass, the system includes a recirculating pump to pass the bottoms from the evaporator through the heater continuously.

The heater is a square combustion chamber, whose stack is equipped with a helical coil of 1¼-inch pipe. Both inlet and outlet from the heating coil are at the top, with flanged connections attached to the transfer lines. A thermostat-controlled fuel valve feeds gas to the combustion chamber to maintain the required temperature on oil leaving the coil. From the coil the oil flows to the evaporator, a vertical vapor-tight shell with the hot-oil inlet near the top head.

A duplex steam pump is used to circulate the bottoms from the evaporator to the heating coil. Regular valves on this pump have been replaced with spring-loaded check valves. A special fluid chamber head is made of a heavy block of steel bored with holes which center over the valve ports in the fluid end. Outside connections are welded to this false head so that the reciprocating movement of the plungers can move fluid back and forth when the pump is operating.



Retort which contains a helical coil in the stack on the furnace to heat the absorption oil being reclaimed.

Ejector at top of receiving drum used to obtain adequate distillation of absorption oil without excessive heat.

Two-inch jacketed lines, flanged to these special fittings, extend from the pump to the evaporator. The jacket of four-inch pipe allows water circulation to keep the pump fluid end cool. Each jacketed line contains two spring-loaded check valves, one close to the evaporator shell and the other in the line leading from the line to the heating coil. The checks forming the discharge valves are in vertical risers which are joined downstream with the line to the heater. The valves operate opposite to each other, so that, when the pump piston takes suction, oil is drawn from the evaporator into the water-jacketed line, and when the piston returns the stroke this oil is discharged through the other valve to the heater line. While oil from the evaporator never passes through the piston chambers, heat by transmission passes to the pump body, and might damage the parts if not cooled with the jacketed line.

To prevent the necessity of maintaining a relatively high temperature on the oil in the evaporator, a steam-operated ejector is mounted on top of the distilled-absorption-oil accumulator drum outside the cooling tower. Since there are no vapors removed from the accumulator, a small ejector is adequate for maintaining a vacuum as high as desired. By using vacuum to pull the vapors over from the evaporator to assist vaporization of the absorption oil at a relatively low temperature, the accumulator tank is also subjected to a vacuum which requires that the accumulated oil be pumped. A small reciprocating steam pump is sufficient for this purpose and discharges the clean oil back into the system.

Prediction of Ignition Points of Diesel Fuels in the Laboratory

G. VORBERG

Translated from Oel u. Kohle, Vol. 15, July 1, 1939

EVEN though the valuation of Diesel fuel oils in the engine is the final test for their burning characteristics, rather than a final laboratory test, the fact that a laboratory test is usually cheaper, quicker, and much simpler, makes it an interesting problem to devise such laboratory procedure.

The combustion of Diesel and all other fuels is dependent on the chemical composition and the structure of the hydrocarbon molecules in such fuels. Ease of combustion or low ignition points of a fuel increases from the ring-structure aromatics, through the naphthenes' olefines, and is highest in the straight chained paraffins.

Since it has been impossible up to the present to isolate individual hydrocarbon groups with simple methods in any degree of purity, one attacks the problem by seeking some simple physical or chemical index, thus gaining an insight into the chemical structure of the fuel.

The following indices for ignition characteristics have been employed and compared in 42 oil tests of various origins:

1. Content of hydrogen.
2. Aniline point.
3. Diesel index.
4. Cetane value (determined by Marder's density method).
5. Cetene-cetane number, determined in I. G. test motor; also in C. F. R. test motor, as a comparison for above four tests.

Hydrogen Content

The relation between hydrogen and carbon is different for individual hydrocarbon groups, the hydrogen increasing in the order of the above-mentioned series. Holde, Constam and Schlapfer et al therefore come to the conclusion that the hydrogen content is an index for ease of ignition in Diesel fuels.

As is shown by all of the four test methods, this seems not always to be the case.

Fifteen percent of the tests comprising these methods show that the hydrogen content test runs counter to the indices obtained by the other methods. This is especially noticeable in No. 1 series of tests for oil No. 7. The poor ignition qualities are thus indicated by all the tests, while the hydrogen content of this oil would indicate it possesses excellent ignition tendencies. A similar picture is seen in the case of oil No. 8. Its good qualities are indicated by all the remaining tests, while the hydrogen content indicates a fuel of poor ignition tendencies.

One is forced to conclude that hydrogen content as an ignition index for Diesel fuels is not reliable. A few Diesel motor companies still adhere to this test in recommending certain fuels for their engines.

Aniline Point and Diesel Index

Density and aniline point decrease in the above-mentioned series of hydrocarbons. This underlies the determination of aniline point and Diesel index.

The British Standard Institution specifies an aniline point of at least 60° C. in its tests for fuel oils required for high-speed small cylinder engines. For engines of medium speed (stationary and marine), the specification for this test is at least 45° C.

According to Tropsch and Simek[1] the aniline method fails with mixtures containing more than 50 percent aromatics.

Holde[2] states: "Aromatics have a critical solution-temperature with aniline far below 0° C. Saturated naphthenes between 30 and 60° C., and paraffin hydrocarbons from 75 to about 100° C."

TABLE 1

Eleven Petroleum Diesel Fuels of Various Origins

(First Series)

Oil No.	NAME	Spec. Grav. 15° C.	Hydrogen (%)	Aniline No.	Diesel Index	Cetane Value (Marder)	Cetane Value I.G. Test Motor
1	Maracaibo gas-oil	0.844	13.3	60.5	51	57	44
2	Normal gas-oil	0.850	13.1	62.5	51	59	54
3	Normal gas-oil	0.858	13.1	58.0	45	57	50
4	Normal Diesel-oil	0.870	12.7	54.0	40	53	41
5	Normal Diesel-oil	0.879	12.5	62.0	42	55	46
6	Special Diesel-oil	0.891	12.4	54.0	35	53	42
7	French gas-oil	0.893	12.5	53.0	32	45	36
8	Persian gas-oil	0.897	12.4	69.0	40	68	63
9	Port Arthur fuel-oil	0.902	12.3	54.0	32	50	40
10	Aruba Diesel-oil	0.905	12.2	50.0	30	49	37
11	Aruba Diesel-oil	0.915	12.1	46.0	25	45	35

TABLE 2

Thirteen Petroleum Diesel Fuels from Holland (Delft.)

(Second Test Series)

Oil No.	Spec. Grav. 15° C.	Aniline Point	Diesel Index	Hydrogen % (Marder)	Cetane No. (Marder)	Cetane Number I. G. Motor	Cetane Number C.F.R.
1	0.854	63.5	49	13.0	62	46	46
2	0.895	53.0	33	12.4	56	41	39
3	0.945	45.5	22	11.5	41	31	26
4	0.927	10.0	10	11.8	26	23	21
5	0.833	74.0	62	13.2	73	54	54
6	0.894	63.0	39	12.4	74	45	36
7	0.949	36.	16	11.5	38	28	28
8	0.884	62.	40	12.5	59	43	38
9	0.875	75.	49	12.6	67	55	49
10	0.874	60.	42	12.7	59	43	40
11	0.880	70.	46	12.6	60	51	45
12	0.871	67.5	48	12.7	59	50	45
13	0.898	77.5	44	12.3	59	45	38

TABLE 3

Diesel Index =

$$\frac{\text{Aniline Point in °F. x Density in A.P.I. Degrees}}{100.}$$

Knowing the the density and Aniline Pt. in °C., the following table saves time in computing the "Diesel-Index."

Degrees	SPECIFIC GRAVITY AT 15° C.													
	960	950	940	930	920	910	900	890	880	870	860	850	840	830
0	5	5	6	6	7	7	8	8	9	9	10	10	11	12
5	6	7	8	8	9	9	10	11	11	12	13	14	15	16
10	8	9	10	11	12	12	13	14	15	16	17	18	19	20
15	9	10	11	12	13	14	15	16	17	19	20	21	22	23
20	10	11	12	14	15	16	18	19	20	21	22	23	24	25
25	12	13	14	16	17	18	19	21	22	23	24	26	27	29
30	14	15	16	18	19	20	22	23	25	26	28	30	31	33
35	15	16	18	19	21	23	25	27	28	29	31	33	35	37
40	17	18	20	21	22	24	26	28	30	32	35	37	39	41
45	18	19	21	22	24	26	29	31	33	35	37	39	41	44
50	19	20	20	24	26	29	31	33	35	37	40	42	45	48
55	21	22	25	26	28	31	33	36	38	40	43	46	49	51
60	22	24	27	28	31	34	36	38	40	43	46	49	53	55
65	23	25	28	30	33	36	38	41	44	47	50	52	55	59
70	25	26	29	32	35	38	40	43	46	49	52	55	58	61
80	28	31	33	36	39	42	45	48	51	54	58	62	66	69
90	31	35	38	42	45	48	52	56	58	62	67	71	74	78

The Diesel index (Table 3) is in wide use in the United States, Holland and Sweden.

In Sweden the Diesel index is determined according to a modified formula as follows:

$$\text{Diesel index} = 2.367\ (t + 17.8)\left(\frac{1.076}{S + 0.004}\right)$$

where S is specific gravity at 20° C., and t, the aniline-point in degrees C.

The figures given in series 3 tests were taken from the literature,[3] with the exception of the hydrogen content.

The Diesel index in the above table was calculated by the Swedish formula.

The four series of tests show fairly conclusively a good agreement between the Diesel index and the cetene-cetane values by engine test. Test series 4 below shows this still more clearly. The aniline-point method has two disadvantages:

1. In very dark oils, the point of miscibility is difficult to observe.

2. In highly aromatic oils the method is at times not reproducible.

Since highly aromatic oils are very scarce and seldom found in the open market for Diesel fuels, it

TABLE 5

Seven Fuel Oils from Coal-Hydrogenation (Fourth Test Series)

Oil No.	1	2	3	4	5	6	7
Spec. Grav. 15° C.	0.928	0.877	0.859	0.856	0.925	0.853	0.872
Aver. B. P.	270	310	205	324	263	272	234
Cetane No. (Mauder)	32	64	34	77	32	63	39
Cetane No. (I. G. Motor)	26	55	26	69	31	51	41
Percent Hydrogen	10.5	11.5	11.7	11.9	1.6	12.0	11.6
Aniline Point	25	68	6.0	82.5	22.0	67.5	44.0
Diesel-Index	16	48	13	65	16	53	45

TABLE 4

Eleven Petroleum Fuels from Sweden (Third Test Series)

Oil No.	Spec. Grav. 20° C.	Hydrogen % (Marder)	Aniline Point	Diesel Index	Cetane No.
1	0.858	12.9	67.5	50	44
2	0.866	12.7	57.2	42	38
3	0.859	12.8	67.4	50	42
4	0.860	12.8	63.2	47	42
5	0.838	13.3	71.8	59	62
6	0.853	13.0	63.1	49	42
7	0.844	13.1	62.0	51	44
8	0.853	13.0	72.8	55	52
9	0.855	12.9	63.3	49	42
10	0.845	13.1	64.6	52	44
11	0.857	12.9	76.6	56	54

is strange that this method has not been more widely adopted.

Cetene Number by Marder's Density Method

Heinze & Marder[4] have found that the density with the average boiling-point (B. P. index) yield a basic method of quite some value, which the above table clearly shows. The cetene value is determined by Marder's cetene-spindel method, and the "B. P. index" (average B. P.) based on W. Ostwald's work is used in a formula to calculate the final cetane valve.

The B. P. index signifies a figure depending on the size of the molecule which has a strong bearing on the ignition-point of the fuel since the bigger the molecule, the less its chemical resistance toward decomposition and oxidation.[5] The cetene number (Marder's method) is also of value as a test method for determining the ease of ignition of fuels and is being used as such.

Summary

Summarizing the results of 42 oil tests it has been shown that the Diesel index and the cetene value (by Marder) are well adapted as laboratory methods for determining the fuel or ignition characteristics of Diesel fuels, which are widely distributed and used in commerce and industry.

It would be interesting also to see published the results of other technologists in this research on Diesel fuels. (Compare other methods.) Combined researches along the lines we have undertaken and reported above aid in establishing a final standard test procedure suitable for oil and engine laboratories to evaluate properly the ignition characteristics of Diesel fuels.

Bibliography

[1] Tropsch & Simek, Transactions Coal Institute, Prague 1931, p. 62.
[2] Holde: Hydrocarbons & Fats, seventh edition 1933, p. 210.
[3] R. Sundstrom, Tech. Tidskr. 20, 76 (1939).
[4] R. Heinze & M. Marder: Oel u. Kohle, 11, 41, 75, 150, 222, 923 (1935). Brennst.-Chem. 17, 441 (1936). M. Marder: Oel u. Kohle 12, 1061 (1936).
[5] W. Lindner: Lecture to Fuel Technological Society Oct. 20, 1938, Hamburg.

Skimming Heat From Cracking Unit

PANHANDLE Refining Company recently revamped its refinery at Wichita Falls so that heat from the cracking unit is used for topping. At the same time, new equipment was installed in the cracking plant, including an upshot furnace, new towers and pumps. In the cracking plant, a second flash column was installed so that the residuum may be controlled to a better advantage as to gravity, flash point and viscosity.

The skimming side of the refinery is separate from the cracking section, but dependent upon it for heat. Instead of a skimming pipe still as in conventional plants, the crude passes through several exchangers and two salt-settling drums before it is flashed to one of two bubble towers for the manufacture of straight-run gasoline. The first bubble tower in the skimming section removes only straight-run gasoline, while the second tower is restricted to naphtha, kerosene, diesel-fuel distillate and topped crude.

The fresh crude is pumped through an exchanger on the kerosene stream and passes through the second bubble tower overhead vapor exchanger to the first salt-settling drum. Without further application of heat, the charge enters the second salt drum and from this vessel exchanges heat with overhead vapors from the cracking plant first fractionating column and goes to the first bubble tower of the skimming section. Gasoline is produced and fractionated to end point with condensate pumped back over the top, and, to increase the recovery of this material, the bubble tower is equipped with a base heater, or reboiler, whose heat is obtained from the cracking plant residuum exchanger and product cooler.

The cracking plant contains a first and second fractionator, the second furnishing a side cut to exchange with the crude in process at the inlet of the second bubble tower of the skimming section, with the side-cut heating medium at 595° F. Topped crude is pumped from the base of the skimming section second bubble tower to the first fractionator of the cracking unit above the stripping trays below which the vapors from the cracking plant flash chamber enter. The side cut which is used to heat the crude at the entrance of the skimming section second bubble tower is pumped back to the first fractionator at the same point that the charge enters.

Double Section Furnace

Topped crude is picked up from the base of the first fractionator by one side of a dual hot-oil charge pump. The other plunger of this pump takes suction from the base of the cracking plant second fractionator for the light oil charge to the cracking furnace. The pump is operated by a 190-horsepower, vertical four-cylinder gas engine directly connected through a speed-reducing gear case.

The tubes in the furnace are 38 feet long and are arranged in two sections, one side for the heavy hot oil and the other for the light hot oil. Both leave the furnace and enter a reaction chamber through separate nozzles at the top, with the heavy-oil transfer at 915° F. and the light-oil transfer at 1015° F. Both commodities, now a common stream, are arrested for cracking reaction at the outlet from the chamber, which is maintained at 275 pounds pressure, and travel to the flash chamber which is operated with a heavy wall wash.

The outlet from the flash chamber is equipped with a liquid-level controller which is connected to two points. One connection leads to the residuum cooler, and the other to the second flash chamber which is equipped with a distribution spray to break up the commodity as it is reduced from a pressure of 95 pounds, on the conventional flash chamber, to 25 pounds on the second column. It is in this column that the fuel oil is controlled to the desired flash and viscosity by varying the height of the liquid level and by varying the amount of wall wash in the preceeding flash tower. Vapors from each flash tower are vented to the cracking plant primary fractionator, that from the conventional column entering at the base below the stripping trays, and that from the second flash tower connected to the line which carries the topped crude from the skimming plant second bubble tower.

Reflux Control

Overhead vapor from this column is controlled with reflux pumped back from the base of the second fractionator, which is the product used for the light-oil cracking section of the plunger pump. Heavy ends in the overhead vapor are knocked back to be fractionated and finally accumulated in the base to form part of the charge for the heavy-oil hot-oil pump. Two products are taken from the secondary fractionating column, the overhead being cracked gasoline and the light oil for cracking.

Liquid Yield 93.8 Percent

The second column is controlled for an overhead temperature of 400° F. with a stream condensed from vapors taken from the second tray at the top and pumped back at the rate required. Top vapors enter a conventional clay tower for the removal of gums; the bottoms returned by pumping to the base of the first flash chamber and the vapors vented to an after-fractionator which is operated at a top temperature of 305° F. These vapors are condensed and enter the cracked gasoline receiver. Liquids are pumped from it with part returned to the after-fractionator and the bulk entering the combination stabilizer and absorption column. A liquid cut taken from the second tray of the after fractionator is cooled and pumped to the top section of the combination absorber and cracked gasoline fractionator to serve the purpose of an absorption oil for recovery of uncondensed material fractionated out of the stabilizer charge.

The stabilizer is operated at a pressure of 85 pounds and is maintained with a base temperature of 270° F. Gases from the overhead are used as fuel for the cracking furnace. Liquid products from the base of the column are vented at process pressure to a stabilizer flash tower from which cracked gasoline at the desired vapor pressure is directed to storage, while the overhead is condensed and flows to ab-

sorption gasoline tankage, from which it is withdrawn as occasion demands for blending with other products of the refinery.

On a representative run residuum from the cracking plant secondary flash tower had an API gravity of 5.4° and a Furol viscosity of 235 seconds at 122° F. The flash point of this fuel is normally at 182°, Pensky-Martens, but this can be varied by manipulating the conditions in the second flash column. The yield of products when operating the heat exchanger on the skimming section is 93.9 percent liquid recovery with the remainder of the charge being gas and operating loss.

Charge of crude to skimming section

Gasoline recovery	64.2 percent
Kerosene	3.9 percent
Distillate	5.0 percent
Diesel Fuel	3.4 percent
Fuel Oil	17.4 percent
Gas and Loss	6.1 percent
	100.0 percent

Short-Cut Analysis

B. G. ADAMS

Chief Chemist, El Tejon Oil & Refining Corporation

THE time required to obtain results of analysis frequently render them of little value. In the cases quoted it is more important to expedite the work than to gain a degree of accuracy not in keeping with the requirements.

Doctor Treating Improvements—Mercaptan

Estimation of the amount of mercaptan sulphur (R.S.H.) present in gasoline prior to treatment is helpful in preparing the treating agents. This can be done quickly in the following manner.

Reagents:

Copper Sulphate

3.91 grams $CuSO_4 . 5H_2O$/Liter

Dissolve Copper Sulphate in about 900 cc. distilled water and add Concentrated Amonium Hydroxide (NH_4OH) until solution is a clear dark blue, then dilute to one liter. 1 cc. = 0.001 gram R.S.H.

Procedure:

Measure 100 cc. of gasoline into a separatory funnel. From a burette filled with the above solution add 5 cc. at a time shaking after each addition until the blue color disappears. As the end point is approached the blue color is more difficult to remove. At this point reduce the additions to 1 cc. When the blue color fails to disappear the end point has been reached.

Calculation:

$$\%\text{R.S.H.} = \frac{\text{cc. } SuSO_4 \text{ sol}}{100 \times \text{specific gravity of gasoline}}$$

Lead

The number of pounds of lead to be added to a partially spent doctor solution can not be quickly determined by the well known amonium molybdate method, whereas only three or four minutes are required using the sodium sulphide test which is not generally used because difficulty is encountered in detecting the end point in the usual lead acetate indicator. This is accomplished by the use of sodium nitroprusside as an outside indicator.

Reagents:

Sodium Sulphide

24 grams per liter

Sodium Nitroprusside

1% solution in distilled water + 1 cc. N/20 sulphuric acid per liter.

Procedure:

Into a 4-oz. bottle is pipetted exactly 10 cc. of the doctor solution to be tested, together with about 10 cc. of distilled water. After each 1 cc. addition of sodium sulphide from a burette shake for 30 or 40 seconds and contact the sodium nitroprusside drops on a previously prepared spot plate with the solution adhering to the end of a glass stirring rod which has been dipped into the solution in the 4-oz. bottle. A distinct end point will be seen when the required amount of sodium sulphide has been added to effect an equilibrium.

Calculation:

lbs. PbO/bbl. = cc. $Na_2S \times 0.22$

Sulphur

In the interval between the amount of sulphur required to precipitate the lead sulphide and the amount tolerated in passing the copper-strip corrosion test, there is present sulphur in quantities sufficient to seriously impair tetraethyl lead susceptibility in doctor-treated gasolines. The lamp sulphur procedure is impracticable because of the time element. While the accuracy of the test using Butyl Mercaptan,[1] is not comparable, very good results can be obtained with a little practice.

Solutions:

n butyl mercaptan, 1 cc. in 1400 cc. of sulphur-free naphtha. Doctor solution, 125 grams NaOH and 25 grams PbO/liter.

Procedure:

Filter 30 cc. of the gasoline into a 4-oz. bottle, 20 cc. of butyl mercaptan solution and 10 cc. of doctor solution. Shake for 20 seconds.

Interpretation:

If the color at this time is a yellow-green the gasoline will pass the copper-strip corrosion test. The amount of sulphur is inversely proportional to the time elapsed until the mixture turns a brown red. In the gasoline from the crude oil in one field 30 minutes is considered excellent, however, regional conditions alter the time factor. This necessitates an initial correlation with the lamp sulphur. A brown red at the start is indicative of bad corrosion.

Specific Gravity of Gases

It seems paradox that a method so simple, inexpensive and accurate is so little known. It eliminates the use of the gas balance and accessories and is accomplished in a fraction of the time with a much smaller sample. The sample is collected through a calcium chloride drying tube into a glass balloon equipped with two stop cocks. After disconnecting the balloon bring the contents to atmospheric pressure by opening one of the stop cocks momentarily. Weigh on an analytical balance the balloon and gas (weight a), evacuate the balloon and weigh again (weight b), open one stop cock and weigh the balloon and air (weight c). Specific gravity $= \frac{a-b}{c-b}$.

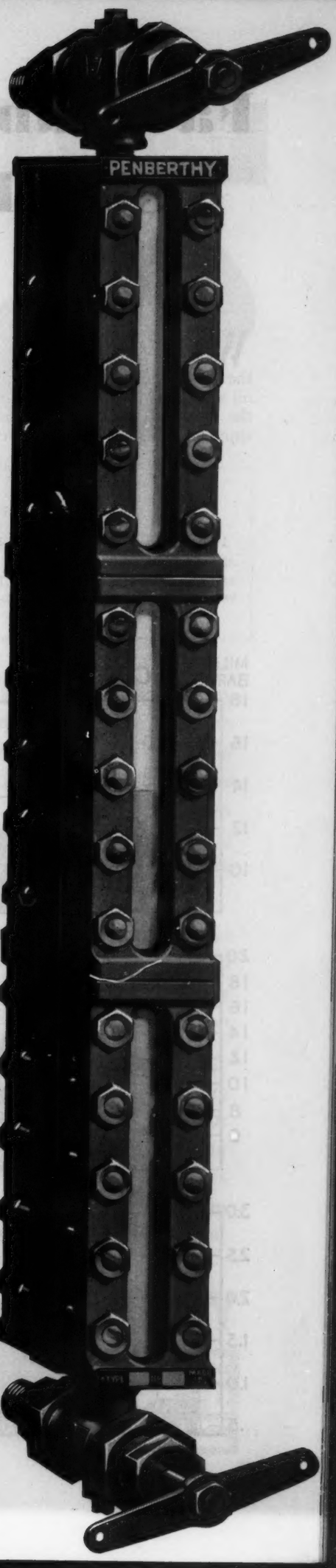
[1] Made by Eastman Kodak Company.

PENBERTHY

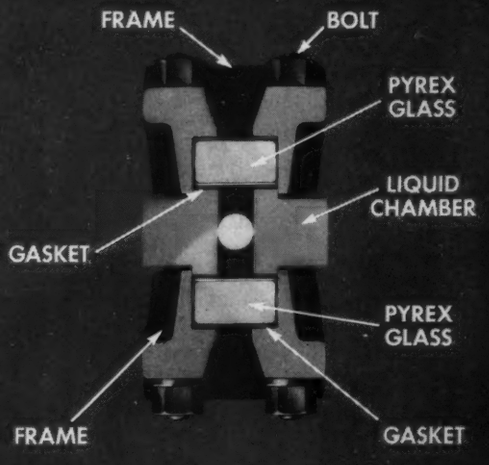
DROP FORGED STEEL

TRANSPARENT

LIQUID LEVEL GAGES



To observe the color or density of liquids under high pressures and/or temperatures



Made of alloy temperature resisting steel. Liquid chamber for single or multiple section gage is made of a solid block of steel the full width of frame to assure perfect alignment and rigidity. Frame has an extra heavy beam at each end and glass chamber is accurately machined to the contour of the glass providing full metal backing for the gaskets. Pyrex glass has greater resistance to thermal shock and erosion.

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Favorable Results Achieved in Supplying the East Coast

L. J. LOGAN

WHILE debate continues as to the seriousness of the threat of an oil shortage on the East Coast during the fall and winter, the industry is supplying oils in unprecedented volumes to that region as well as the rest of the country, and it may be expected to continue to furnish record-breaking quantities to the East and to other parts of the country, unless additional heavy inroads are made into its facilities by tanker diversions.

This achievement of supplying materially increased demand with a greatly reduced tanker fleet, through increased efficiency of remaining ships and substitution of other means of transportation, has attested the ingenuity, resourcefulness, and dependability of the industry in time of emergency; and in the existing circumstances, the industry obviously cannot be blamed for any necessity heretofore or during the fall and winter of applying brakes upon the record-breaking demands for its products.

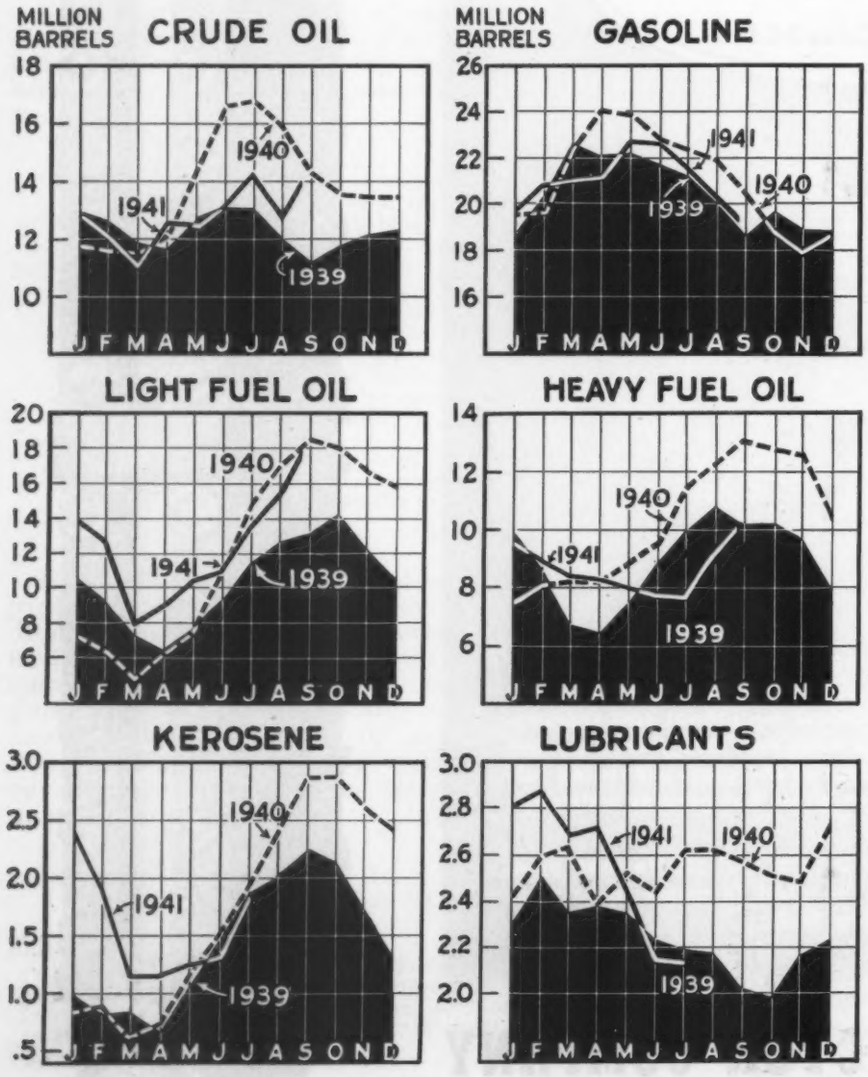
So far, the only restriction on consumption that has been deemed advisable has been the mild curtailment of deliveries of gasoline to Eastern service stations during August, September, and October, apparently amounting to less than 10 percent and leaving sales greater than a year ago; and no tightening of such curtailment is contemplated up to now by the oil coordinator's office.

Similarly, while conservation of heating oil is urged, no necessity is seen at present for extending restrictions on Eastern deliveries to include that product; and if the winter is not exceptionally severe, there may not be necessary, henceforth, for any official curtailment of heating-oil use.

On the other hand, it appears quite possible that discouragement of the use of residual, or heavy, fuel oil on the East Coast may be necessary, because of the scarcity of tankers. Eastern stocks of that product are nearly 20 percent lower than a year ago, while consumption is running nearly 20 percent higher; and to increase supplies would require use of ships urgently needed for bringing in heating oil and gasoline. However, use of the heavy fuel oil is more susceptible to curtailment than is consumption of most of the other products, as some users may without great inconvenience substitute coal. Only about 50 percent of the total use is inflexible, that is, not susceptible to convenient or economical

East Coast Stocks at End of Month

Inventories of crude, light fuel oil, and kerosene are about same as year ago. Stocks of gasoline, heavy fuel oil, and lubricants are smaller. Source of data: Bureau of Mines to July 31, 1941; August 31 and September 20, 1941, from American Petroleum Institute.



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substitution, the inflexible users being ships, railroads now using oil, to some extent the oil companies, and some consumers who use the product for heating; flexible users being the gas and electric power plants and most industries, which normally vary their consumption as the price of residual fuel oil goes up or down. Already, prospective Eastern purchasers are having difficulty in contracting for supplies of the heavy fuel oils for fall and winter delivery, and scarcity of supplies doubtless will continue until the shortage of tankers is alleviated.

Considerable relief has been gained through use of tank cars, and much more doubtless will be realized. Apparently, the chief deterrent has been the unwillingness of government authorities as well as oil companies to face the fact that the desired objective might be gained—for a price: the price of higher transportation charges by rail than by tanker, which eventually would have to be passed on to the consumer. Finally, however, there has been such a facing of facts by both the government and the industry, with the result that the oil companies have agreed to make maximum possible use of tank cars, with the understanding that price control authorities will approve any necessary increases in prices to compensate for the higher transportation costs.

Aside from the physical considerations, increased rail movement of oils to the East, with due adjustment of prices, appears practical from the standpoint of the possibilities afforded for a natural, economic influence on demand itself. Required to pay more per gallon for gasoline, consumers might of their own volition cut down on their consumption and thus reduce the apparent scarcity.

Attesting that the East Coast scarcity so far has not become alarming are the latest trends in stocks of the principal products and in water shipments to the district, as shown in accompanying charts.

A study of the charts on East Coast stocks reveals these situations, which on the whole are comforting:

1. *Crude stocks* of the district on September 22, 1941, were at almost the same level as a year previously and were over 2,000,000 barrels larger than two years earlier.

2. *Gasoline stocks* near the end of September, 1941, were more than 1,000,000 barrels smaller than those held a year previously, but the latter were so excessive as to depress prices close to all-time record low levels. As compared with two years ago, when there was likewise a surplus above operating requirements, present gasoline stocks show some increase.

3. *Light-fuel-oil stocks* in the East are practically the same now as a year ago, when the industry was congratulating itself on a comfortable surplus; and totaling around 18,000,000 barrels, they are 5,000,000 barrels or 40 percent greater than two years ago, when there lay ahead an exceptionally severe winter during which the industry nevertheless managed to avert an East Coast shortage of heating oil.

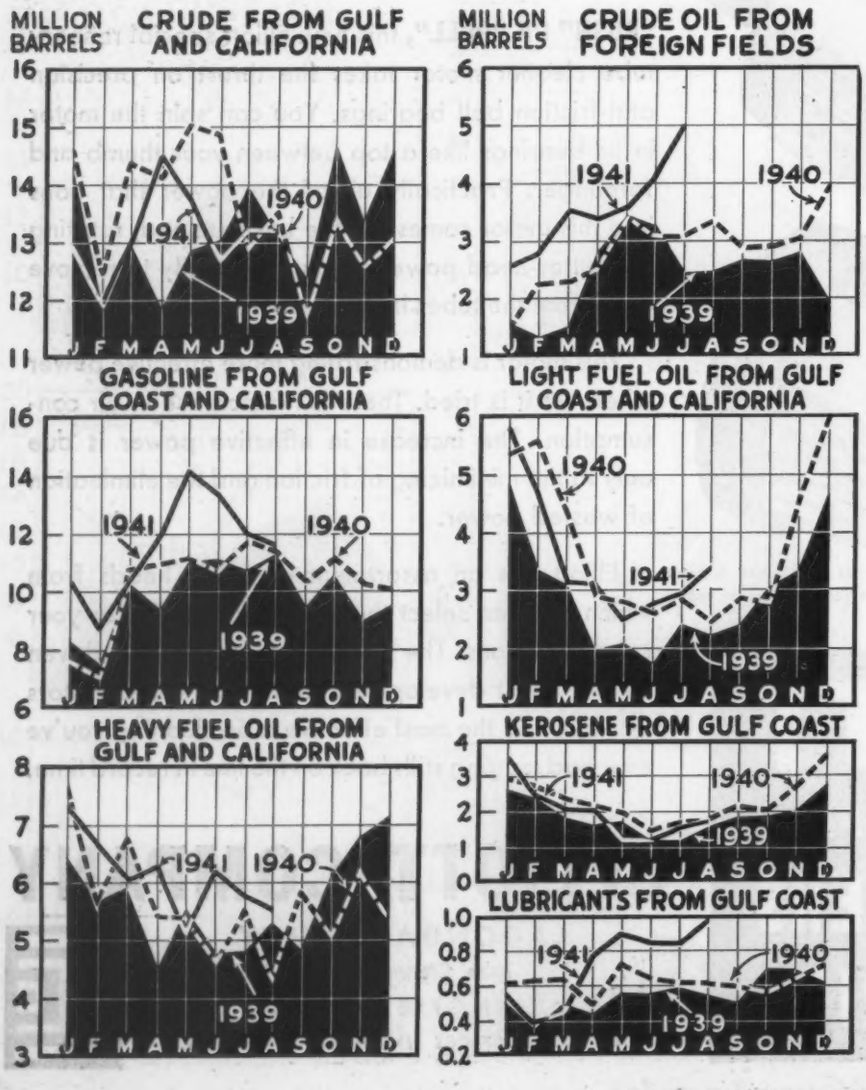
4. *Heavy-fuel-oil stocks* on the East Coast are about the same as two years ago but 2,500,000 barrels smaller than a year ago, indicating that some users may be obliged to substitute coal for fuel oil in coming months, a move that would not be greatly inconvenient or uneconomic in many instances.

5. *Kerosene stocks* in the East have been following about the same trends as in the past two years and never are of relatively great volume, August 1 inventories of nearly 2,000,000 barrels having compared with the high of less than 3,000,000 barrels as of November 1, 1940, and a high of about 2,250,000 barrels for October 1, 1939.

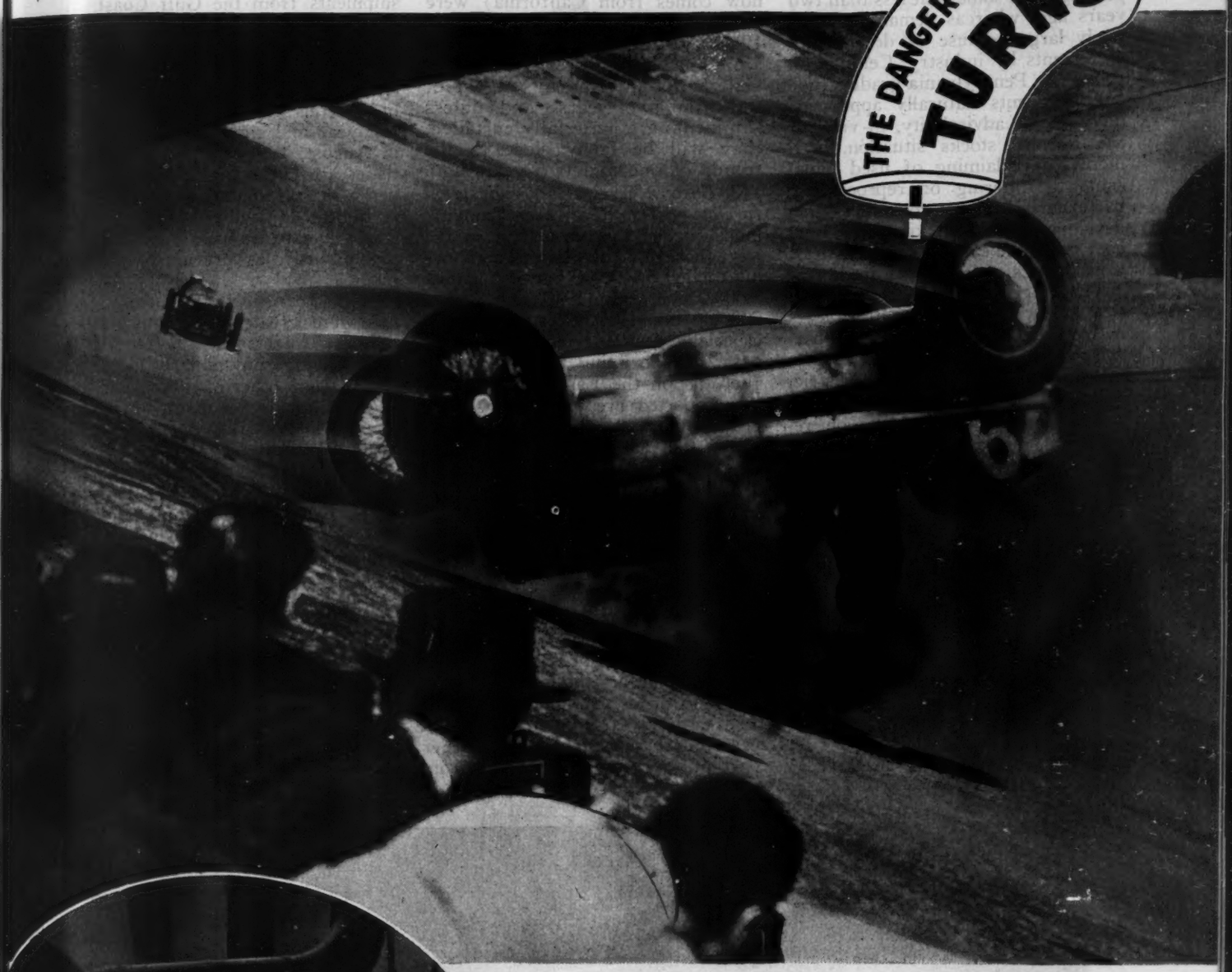
6. *Lubricants in storage* on the East Coast probably offer more cause for concern than do the stocks of some of the other products, being

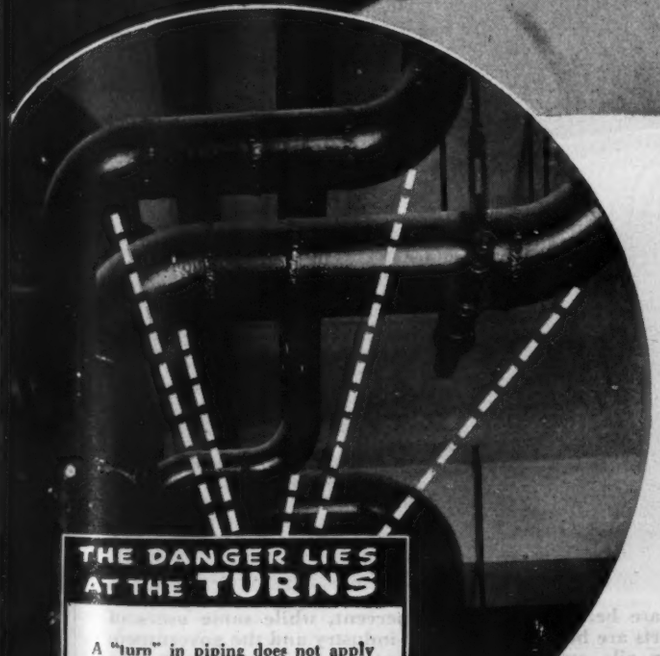
Monthly Receipts at East Coast Ports

Crude coming in from foreign fields in exceptionally large volumes and from Gulf Coast at about same rate as year ago. Receipts of gasoline, light fuel oil, heavy fuel oil, and lubricants from Gulf Coast greater than last year, and kerosene receipts normal. Moreover, Eastern receipts now include lately inaugurated pipe line and rail movements, which are not incorporated in charts. Source of Data: Bureau of Mines.



IN YOUR PIPING SYSTEMS, TOO . . .





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15 percent less voluminous than a year ago and somewhat less than two years ago, whereas demand is relatively large because of defense requirements by industry. Ceilings on prices of Pennsylvania-grade crude and lubricants naturally appear of questionable advisability, in view of the Eastern stocks situation. And increased reclaiming of used lubricants by filtering or reprocessing, particularly by large consumers, is a development to be expected. However, as in the case of kerosene, East Coast stocks of lubricants are not of relatively great volume, having fluctuated during the past three years between 2,000,000 and 3,000,000 barrels; and serious difficulty in supplying all requirements of the district appears remote.

The accompanying charts on receipts of oils at East Coast ports, like those on stocks, are generally encouraging in nature, especially when it is considered that currently, the district is receiving substantial shipments of oils by pipe line and railway tank car, which are not shown on the charts, the data taking into account only shipments by water from the Gulf Coast, California, and foreign countries, which until recently accounted for the bulk of all receipts.

Examination of the charts shows the following facts:

1. *Eastern receipts of crude oil by tanker from the Gulf Coast* (none now comes from California) were approximately the same in August, 1941, latest month for which figures are available, as receipts from the Gulf and California in August of the past two years; and unless shipments are materially curtailed, they will be fairly close to the trends of one and two years ago.

2. *Eastern receipts of crude from foreign fields* have been running much higher this year than in the past, those for July, latest data, having totaled 5,000,000 barrels, against 3,000,000 in July, 1940, and 2,500,000 in July, 1939. This situation is especially desirable from the standpoint of alleviating the scarcity of fuel oils on the East Coast, as the oils imported are principally heavy crudes that are used for making heavy fuel oils and to some extent light fuel oils. The increased shipments from Venezuela, Mexico, and other countries to the south help to compensate for any lagging of receipts from the Gulf Coast, in so far as supplying the East Coast is concerned.

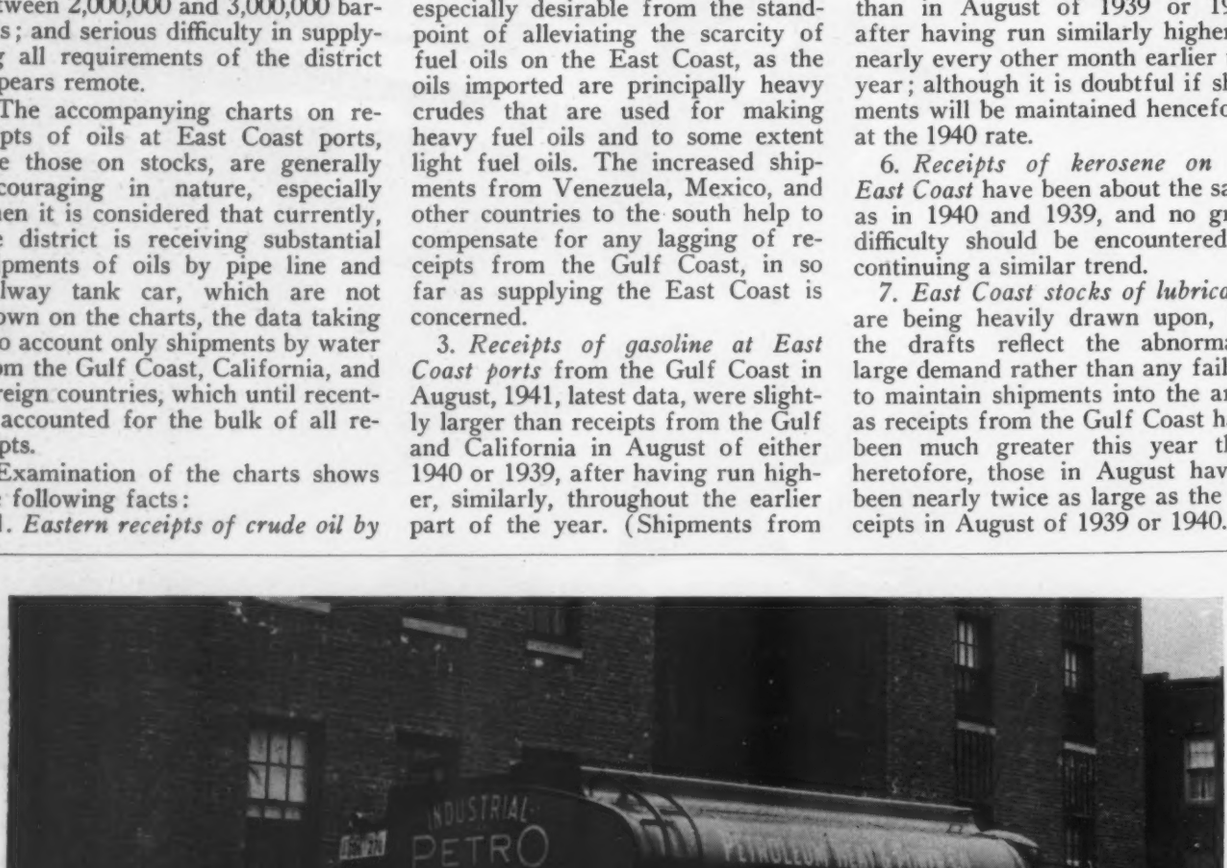
3. *Receipts of gasoline at East Coast ports* from the Gulf Coast in August, 1941, latest data, were slightly larger than receipts from the Gulf and California in August of either 1940 or 1939, after having run higher, similarly, throughout the earlier part of the year. (Shipments from California have been replaced by shipments from the Gulf Coast, in order to make the most efficient possible use of tanker tonnage.)

4. *Eastern receipts of domestic light fuel oils* in August were a million barrels larger than in August of last year and similarly greater than in August, 1939; and although statistics are not available for September, a sharp stepping up of deliveries is indicated by the fact that East Coast inventories have been climbing precipitously, as previously pointed out.

5. *Eastern receipts of heavy fuel oils* were greater in August, 1941, than in August of 1939 or 1940, after having run similarly higher in nearly every other month earlier this year; although it is doubtful if shipments will be maintained henceforth at the 1940 rate.

6. *Receipts of kerosene on the East Coast* have been about the same as in 1940 and 1939, and no great difficulty should be encountered in continuing a similar trend.

7. *East Coast stocks of lubricants* are being heavily drawn upon, but the drafts reflect the abnormally large demand rather than any failure to maintain shipments into the area, as receipts from the Gulf Coast have been much greater this year than heretofore, those in August having been nearly twice as large as the receipts in August of 1939 or 1940.



Although deliveries of gasoline to East Coast service stations are being restricted 10 percent, while some users of heavy fuel oil are being obliged to substitute coal, special efforts are being made by the industry and the government to avert the necessity of curtailing Eastern deliveries of heating oil; and heavy shipments of that product to the district are promoting relatively favorable inventory situation. Shown here is the bunkering of a large apartment house in Brooklyn with oil. —Photo by Ewing Galloway, New York.

CGNA Annual Program Fits With Institute Gathering

Both the program and the date for the annual meeting of the California Natural Gasoline Association, Los Angeles, October 31, have been arranged to take care of attendance from other sections of the United States. The meeting comes ahead of the annual meeting of the American Petroleum Institute in San Francisco, November 3 to 7.

The annual technical meeting of the California association allows for summing up activities of the year as well as for the presentation of papers that cover phases of both refining and natural-gasoline manufacture.

The meeting will be held in the Ambassador Hotel. The opening event will be the president's address highlighting the association's relationship to the industry and reporting the accomplishments during the last year. This will be followed by a report of the general technical committee chairman and reports by the chairman of two of the subtechnical committees. These reports will include "Investigation of Standard Methods for Compressor Horsepower Calculations" by Tom Dunlap, Standard Oil Company of California; and "Studies in Standardization of Gauging Methods for the Shipping of Liquid Petroleum Products by Vehicular Units" by W. B. Parks, The Norwalk Company.

The first paper of the meeting will be presented by E. R. Smoley, The Lummus Company, titled "Polyform Process," a discussion of the new polyform cycle and its relation to the utilization of light ends from natural gasoline. The paper will present new pilot-plant data on California stocks, giving yield-octane relationships and economic data. George P. Bunn and Wallace Williams, Phillips Petroleum Company, will present "Human Engineering in the Petroleum Industry." "Partial Volume and Its Significance" is the title of a paper by Dr. B. H. Sage and Dr. Wm. N. Lacey, California Institute of Technology. The paper will define the property and discuss methods by which it can be evaluated in relation to the prevailing conditions under which the mixture exists. A resume of the available information concerning the partial volumes of the lighter hydrocarbons will be presented. The utility of these data in the prediction of behavior of natural gases and gasolines will be discussed and some facts will be offered to indicate the present accuracy of prediction. "Analysis of Hydrocarbon Gas Mixtures by Mass Spectrometry," a paper by Herbert Hoover, Jr., and Harold Washburn of the United States Geophysical Company, will present latest developments in this highly interesting field.

P. C. Dixon of Foran, Boatright & Dixon, will present "Natural Gasoline Plant Practice as Applied to Cycling" which will deal with location and completion of wells, reservoir efficiency, operation of wells as a part of the plant, selection of materials, design and operation of various plant units, selection and care of absorption oil and operation of field lines. "The importance of Natural Gasoline in National Defense" will be presented by a representative of the Petroleum Coordinator's Office.

The evening session will be given over to the annual banquet which will be followed by an entertainment program.

The Look Box

WPRA Technical Meeting at Wichita

Three papers made up the program of the first of the fall technical meetings of Western Petroleum Refiners Association, Allis Hotel, Wichita, Kansas, October 3. Those attending the conference were guests of supply and equipment concerns at a luncheon at noon.

The technical program follows:

"Organic Sulphur Compounds in Petroleum Distillates," Harold Bottomley, chief chemist, Cosden Petroleum Corporation, Big Spring, Texas.

"Operation and Maintenance of Tube Rolling and Cleaning Tools," G. F. Ilgen, Aretool Manufacturing Company, Springfield, Ohio.

"Tractor Fuels and the Problems of the Engine Designer," Frank Sailer and H. S. Manwaring, International Harvester Company, Chicago.

The second technical meeting will be held in the Washington-Youree Hotel, Shreveport, October 17.

NGAA Annual Meeting May 13-15, 1942

The annual meeting for the National Gasoline Association of America will be held May 13, 14 and 15 in the Mayo Hotel, Tulsa. The dates are the three days preceding the opening of the International Petroleum Exposition.

Because the meeting will mark the twenty-first anniversary of the association a program of special features is being arranged.

CONVENTIONS

OCT. 16–18	American Institute of Mining & Metallurgical Engineers, Petroleum Division, Dallas.
17	Western Petroleum Refiners Association, Regional Technical Meeting, Washington-Youree Hotel, Shreveport.
23–24	Society of Automotive Engineers, National Fuels and Lubricants Meeting, Mayo Hotel, Tulsa.
29–30	American Institute of Mining and Metallurgical Engineers, Petroleum Division, Ambassador Hotel, Los Angeles.
31	California Natural Gasoline Association, Los Angeles.
NOV. 3– 5	American Institute of Chemical Engineers, Virginia City, Virginia.
3– 7	American Petroleum Institute, St. Francis and Palace Hotels, San Francisco.
DEC. 1– 6	Exposition of the Chemical Industries, Grand Central Palace, New York.

Ickes and Davies on API Program at San Francisco

Both Harold L. Ickes, petroleum coordinator, and Ralph K. Davies, deputy petroleum coordinator, will appear on programs of the twenty-second annual meeting of the American Petroleum Institute in San Francisco, November 3 to 7. The coordinator will be on the program of the first general session the afternoon of November 5, when the remainder of the program will consist of the report of the board of councillors and election of officials with W. R. Boyd, vice president of the Institute making the report, also an address by Tom Connally, Senator from Texas and chairman of the Senate Foreign Relations Committee.

The second general session November 6 will have Davies, Alfred P. Haeke of the National Association of Furniture Manufacturers, and Commander T. G. Galbraith of the British Supply Council.

The annual reception and dinner of the 25-Year Club will be held the evening of November 5 in the Italian and Colonial ball rooms of the St. Francis hotel. The annual banquet will be held November 6 in the Palace hotel.

The three sessions of the Division of Refining will be held in the Colonial ball room of the St. Francis hotel.

The theme of the session for the morning of November 5 will be Properties of Petroleum with the following papers and reports:

Progress Report on Hydrocarbons in the Kerosene Fraction of Petroleum—A. P. I. Research Project 6, F. D. Rossine and B. J. Mair, National Bureau of Standards, Washington.

The Synthesis and Properties of Hydrocarbons of High Molecular Weight, J. N. Cosby and L. H. Sutherland, Pennsylvania State Colelge, State College, Pennsylvania.

Characteristics of California Crude Oils, R. C. Mithoff, G. R. McPherson and F. Sipos, Standard Oil Company of California, San Francisco.

Refining processes will be the topic for the second meeting of the division, November 6:

Precise Fractionation in 1000-Barrel Commercial Stedman Unit, L. B. Bragg, Foster Wheeler Corporation, New York, and F. Morton, Trinidad Leaseholds, Ltd., Trinidad, B. W. I.

Naphtha Treating Pays Its Way, C. F. Mason, R. D. Bent and J. H. McCullough, The Atlantic Refining Company, Philadelphia.

Reaction Chambers on Thermal Cracking Units, R. C. Mithoff and L. F. Schimansky, Standard Oil Company of California, San Francisco.

New Oil-Decolorizing and Clay-Reactivating Process, W. B. Chenault and A. E. Miller, Sinclair Refining Company, New York.

The final session of the refining division, November 7, will be on automobiles and automotive petroleum products:

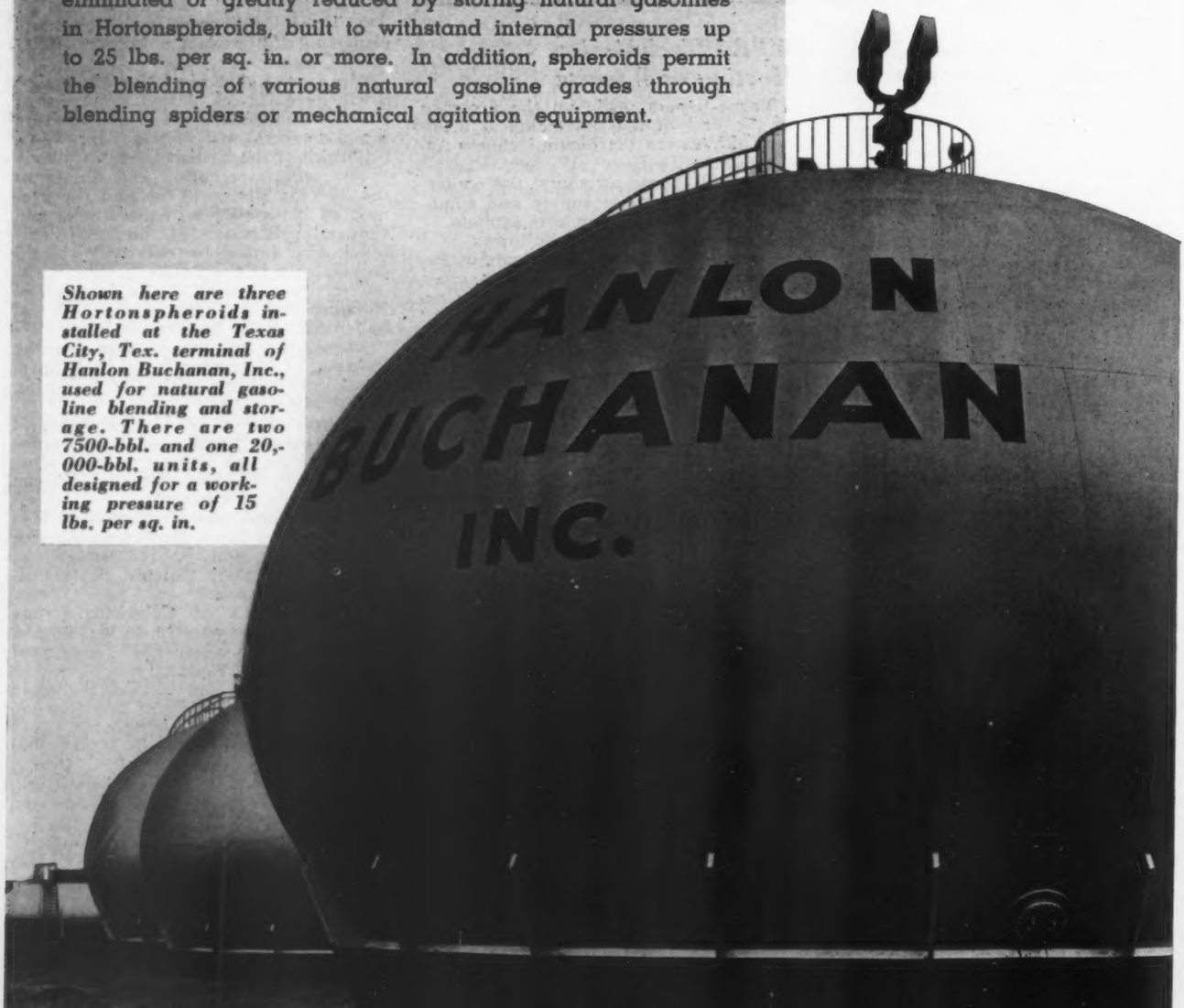
Improved Motor Fuels Through Selective Blending, C. R. Wagner, W. B. Ross, L. M. Henderson, The Pure Oil Company, Chicago, and T. H. Risk, Ethyl Gasoline Corporation, Detroit.

1941 Road Detonation Tests—Further Experiences with New Methods of Test, compiled from the report of the Cooperative Fuel Research Committee by J. M. Campbell, General Motors Corporation, Detroit; R. J. Greenshields,

HORTONSPHEROIDS

—a logical choice for Storing or Blending NATURAL GASOLINE

• Ever-increasing quantities of natural gasoline are being produced daily to meet the heavy demand for high-octane aviation and motor fuels. It is an established fact that costly evaporation losses due to breathing, boiling, or filling can be eliminated or greatly reduced by storing natural gasolines in Hortonspheroids, built to withstand internal pressures up to 25 lbs. per sq. in. or more. In addition, spheroids permit the blending of various natural gasoline grades through blending spiders or mechanical agitation equipment.



Shown here are three Hortonspheroids installed at the Texas City, Tex. terminal of Hanlon Buchanan, Inc., used for natural gasoline blending and storage. There are two 7500-bbl. and one 20,000-bbl. units, all designed for a working pressure of 15 lbs. per sq. in.

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Birmingham	1548 N. Fiftieth St.	Cleveland	2234 Builders Exchange	San Francisco	1051 Rialto Building
Havana	402 Edificio Abreu	Philadelphia	1608-1700 Walnut St.	Los Angeles	1434 Wm. Fox Building

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LICENSEES: Horton Steel Works, Limited, Fort Erie, Ontario, Canada; The Motherwell Bridge & Engineering Co., Ltd., Motherwell, Scotland; The Whessoe Foundry & Engineering Co., Ltd., London, England; Worms & Cie., Paris, France; Compagnia Tecnica Industrie Petroli S.A.I., Rome, Italy.

Shell Oil Company, Wood River; W. M. Holaday, Socony-Vacuum Oil Company, New York; and C. B. Veal, Society of Automotive Engineers, New York.

1941 Automotive Survey Report.

"Lubrication of Test Chevrolet Engine," J. E. Moller, The Pure Oil Company, Chicago.

The report of the nomination committee will be made by R. A. Halloran, Standard Oil Company of California, San Francisco, after which 20 members of the general committee of the Division of Refining will be elected.

NGAA Organizes High Pressure Gas Division

Natural Gasoline Association of America has created a High-Pressure-Gas Division, which will function in the study of problems that come largely out of the recovery of distillate through recycling. The division was formed at a meeting of the board of directors, which elected E. E. DeBack, general manager of Chicago Corporation, Corpus Christi, to a vice presidency. Previously he had been president of the American Recycling Association, which was formed in November, 1941, at Kingsville. Other officials of this association were Dr. O. L. Roberts, The Atlantic Refining Company, Philadelphia, vice president; and R. L. Peurifoy, Texas College of Arts and Industries, Kingsville, Texas, secretary-treasurer.

At that time, due to diversified interests, several N.G.A.A. committees already were engaged in research problems concerned with high pressure gas testing and measurement. These studies duplicated work planned by American Recycling Association. Informal talks with members of that organization brought the conclusion that a more practical approach will be that adopted at the meeting in Tulsa.

The new division will be an integral part of Natural Gasoline Association of America, with headquarters at 933 Kennedy building, Tulsa, although most of its meetings will be in centers near the distillate areas. It will function as a large special N.G.A.A. special committee with its activities under direction of the N.G.A.A. board of directors. For the present it will have two working groups, a testing and sampling committee and a gas-measurement committee. Other committees will be formed as needs arise.

Subjects already planned for study include: high pressure gas transmission problems; sub-surface flow conditions; methods for removal of salt and hydrogen sulphide from gases, and study of liquid entrainment in high pressure gas streams. The testing and sampling committee will begin at once the study of present methods of testing high-pressure gases to determine their specific gravity and liquid content and also methods of obtaining a representative sample of such gases. The N.G.A.A. gas testing committee has made a detailed survey of present practices on all three subjects and this information will be turned over to the new group. Field studies to compare results obtained by the various methods and equipment on identical gases and under the same conditions will be undertaken in the near future. Similar N.G.A.A. studies of high-pressure-gas-measurement methods will also be made available to the new gas-measurement committee which is to proceed with further work on this problem as soon as possible.

To facilitate the work of these committees, tentative plans call for some phases of problems involved to be assigned to engineering schools under special scholarships, though this work will be directly supervised by committee personnel.

E. E. DeBack and Ray E. Miller

J. S. Walton Goes To University of Oklahoma

J. S. Walton, former research engineer for Socony-Vacuum Oil Company and later technologist for Standard Oil Development Company, has been added to the staff of the School of Chemical Engineering, University of Oklahoma, Norman. He will continue his work in catalytic and thermal conversion processes.

After graduation from the University of Iowa in 1928, he went with White Eagle Division of Socony-Vacuum Oil Corporation at its Augusta, Kansas, plant, where he worked on asphalt manufacture, cracking and treating. In 1929 and 1930 he was on the staff of Massachusetts Institute of Technology, where he specialized in work devoted to high-pressure polymerization.

His connection with Socony-Vacuum Oil Company was from 1930 to 1934. He then did consulting work with the Louis de Florez Engineering Company, where he made numerous surveys of cracking processes. He became senior technologist for Standard Oil Development Company in 1937.

He is a member of the American Institute of Chemical Engineers. His work has been published in several technical papers.

J. S. WALTON

National Fuels and Lubricants Meeting

The program for the meeting of the National Fuels and Lubricants meeting, Society of Automotive Engineers, Mayo Hotel, Tulsa, October 23 and 24 has been announced as follows:

October 23, morning session, G. C. Richardson, Cities Service Oil Company, chairman. "Quality Trends in Motor Fuels (Central United States)," R. C. Alden, Phillips Petroleum Company.

Afternoon session, A. L. Heintze, chairman. "Oil Filters," Dr. Ulric B. Bray, consulting engineer; "Diesel Lubricating Problems," A. E. Smith and J. P. Steward, Socony-Vacuum Oil Company.

Evening session, B. E. Sibley, Continental Oil Company, chairman. "What S. A. E. Means to You," John A. C. Warner, general manager of the Society of Automotive Engineers; "Behind the Scenes in National Defense," A. T. Colwell, president of the Society of Automotive Engineers and vice president of Thompson Products Company.

October 24, morning session, C. S. Hansen, Phillips Petroleum Company, chairman. "A Cetane Number Study of Diesel Fuels," W. W. Ainsley, H. D. Young and M. L. Hamilton, Sinclair Refining Company; "Current Solutions of Cooling Problems in Various Uses of Oil, Jacket Water and Special Heat Transfer Applications," H. F. Briney, to be read by L. E. Skelly, Young Radiator Company.

Afternoon session, W. G. Ainsley, chairman. "Changes Occurring in Oils

and Engines from Use," F. A. Suess, Bert H. Lincoln, H. C. Baldwin and W. A. Jones, Continental Oil Company; "Value of Engine Rating System in Correlating Oil Stability Engine Tests," H. L. Hemingway, Kendall Refining Company.

The evening program of the second day when Dr. Ulric B. Bray will be chairman, will consist of the debate on the subject, "Resolved that passenger car crankcase draining every 1000 miles is to be preferred over draining at greater distances." The affirmative side will be taken by students of the college of engineering of the University of Oklahoma while students of the division of engineering, Oklahoma Agricultural College will take the negative.

A.P.I. President Dies At Home in New York

Axtell Julius Byles, president of the American Petroleum Institute, New York, died at his home at Ardsley-on-the-Hudson, New York, the morning of September 28, after an illness of several months. He was 60 years old.

Prior to his election in 1933 to the presidency of the country's largest national trade association representing the petroleum industry, Byles had been president of Tide Water Associated Oil Company, New York, and chairman of the board of its affiliated company, Associated Oil Company, San Francisco.

Byles was born at Titusville, Pennsylvania, October 21, 1880, the son of Julius and Mary Axtell Byles. Educated in the Titusville public schools, he prepared for college at Lawrenceville School, and in 1903 was graduated by Princeton University with the degree of Bachelor of Science. He completed his formal education with two years' study of law, and in 1905 was admitted to the Pennsylvania bar. He then returned to Titusville, where he practiced law until 1917.

Titusville is the site of the 1859 Drake well, the first well in the United States drilled purposely to find oil, and much of the important Pennsylvania oil industry which had its inception in that well has from the beginning centered in Titusville. Naturally in his youth Byles, in common with the other residents of Titusville, was intensely interested in the oil business, the region's major enterprise. When he returned home to practice law, many of his most important cases were connected with oil, and he there got the special training which directed his activities in later years.

In September, 1917, Byles was appointed general counsel of Tide Water Oil Company, New York, a company which had its roots in the Titusville region. He rapidly rose to hold many executive responsibilities in the company and its affiliates. He was elected to its board of directors in May, 1919, became vice president in May, 1922, and president in February, 1924. Two years later, in 1926, he was elected president and director of Tide Water Associated Oil Company, New York, and president and director of Associated Oil Company, San Francisco. In 1927 he became chairman of the board of directors of the latter company.

These positions he held until May, 1933, when he resigned to become president of the American Petroleum Institute. Annually since 1933 he has been re-elected to the Institute's highest office, and to its board of directors.

He was a member of the Adirondack League Club, Princeton Club of New York, Sleepy Hollow Country Club, Manursing Island Club, Cap and Gown (Princeton), Metropolitan Club, and Olympic Club, San Francisco.

Byles married Florence Payne on September 6, 1905, and is survived by her and by their two sons, Axtell Byles Jr., of Mt. Carmel, Illinois, and Lieutenant Julius Byles of the 178th Field Artillery.

A.P.I. President Dies

AXTELL J. BYLES

Oklahoma Technical Club Elects Officials

Officials of the Technical Club of Oklahoma were elected at its first fall meeting, September 29, 1941, as follows: Roy E. Bush, Pittsburgh Equitable Meter Company, president; David B. Hawthorne, Amerada Petroleum Corporation, vice president; Charles Luckfield, Stanolind Oil & Gas Company, secretary-treasurer. John R. Evans, chief engineer of Stanolind Oil & Gas Company, Tulsa, was president last year.

WPRA Technical Group Meets at El Dorado

T. B. Leech, manager of refinery sales for Bethlehem Supply Company, Houston, spoke before the monthly meeting of the technical group of the Western Petroleum Refiners Association at El Dorado, Arkansas, September 12. His subject was "New Refinery Processes—Their Place in National Defense and Effect on Refinery Economics."

James F. Nagle has been elected vice president and general manager of Milan Refining Company, Milan, Illinois. The concern formerly was Taxman Marketing Company.

Chemical Exposition Dates, December 1-6

The Eighteenth Exposition of the Chemical Industries will be held in Grand Central Palace, New York, December 1 to 6, 1941. Process and equipment of particular interest in national defense will highlight the event.

The exposition will comprise as a whole exhibits reflecting the rapid advance of chemical technology in general and also raw materials, machinery and products in the following categories:

Technology: Commercial laboratories, laboratory equipment and supplies, testing instruments and apparatus, chemists' and engineers' consulting services, engineering societies, text books and periodicals.

Industrial Chemicals: Materials used in industrial processes, laboratory reagents and pharmaceuticals; compounds which have technical names and are sold chiefly to manufacturers.

Chemical Products: Compounds manufactured by chemical methods; technical and commercial materials used by a strikingly long list of industries.

Processing Materials: Used by chemical manufacturers in some of their operations, but which are consumed or reused, instead of entering into the market.

Manufacturing Ingredients: Raw, refined and semi-fabricated metals and minerals as well as vegetable products; synthetics, extracts and derivatives; which form the basis of productive operations.

Manufacturing Equipment: The productive organs and arteries of the plant which are permanent and static, and largely chemical in their functions.

Machinery and Supplies: Motive power and specialized apparatus designed to perform mechanical operations, convey materials and supplement chemical processes.

Process Control: Instrumentation and apparatus to indicate, regulate and record critical functions, such as temperature, pressure, moisture content, alkalinity, proportionation of mixtures, rate of feed, liquid level, and so on.

Containers: Dispensing and packaging equipment, storage and shipping, measuring and weighing, bottling, boxing, sealing and labeling apparatus.

Plant Construction: Housing, heating and ventilating, lighting, sound-proofing and many other items contributing to the environment required by modernized industrial operations.

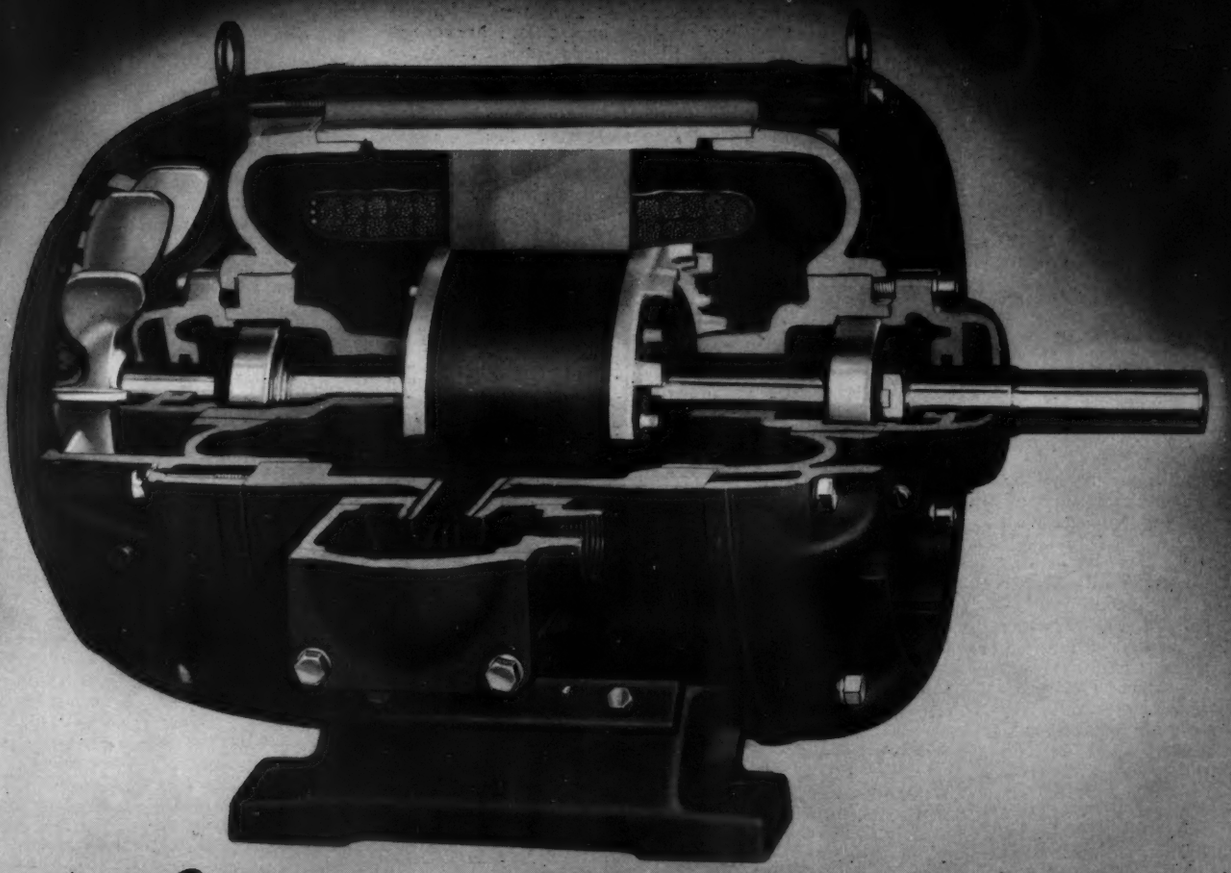
Conferences and consultations between leaders in science and industry, personal contacts, discussions and demonstrations of new problems to be solved and new solutions of old problems—all combine to create the distinctive atmosphere that renders the chemical expositions strictly professional events.

New API Viscosity Standard Announced

The committee on viscosity standards of the American Petroleum Institute has announced a new set of oil standards for viscosimeter calibration. In preparing the new standards two recent developments have been taken into consideration: the general adoption of kinematic viscosimeters in place of Saybolt instruments for routine and control testing; the adoption of kinematic viscosity limits for Diesel fuels.

To meet these conditions the commit-

LOUIS ALLIS



Look Inside!

The Louis Allis EXPLOSION-PROOF motor is built to withstand the force of the greatest explosion possible within its heavy iron walls—with a safety factor of *five!*

With a safety factor of FIVE—the Louis Allis Explosion-Proof has twenty carefully designed specific features—features that make available a new high in electric motor efficiency, dependability, convenience and—SAFETY!

We have prepared a sixteen page booklet which completely illustrates and describes all of these important features—write for your copy—ask for Bulletin No. 508-E.

LOOK INSIDE—compare Louis Allis Explosion-Proof motor point by point with any others on the market—and we are sure you will agree that—here is the finest explosion-proof motor ever built—bar none!

Specify your next explosion-proof motor by name—LOUIS ALLIS—you will be assured of the most complete protection and dependable performance available.

THE LOUIS ALLIS CO., MILWAUKEE, WIS.

tee is offering the oils in two sizes of containers, the quart sample as previously supplied and a half-pint sample for those interested primarily in the calibration of kinematic viscosimeters only, which require only a small volume of oil. The smaller samples also will reduce the tendency of some testers to keep samples in stock over long periods. The committee recommends discarding a sample within eight months after purchase.

The new series consists of three oils, namely Alpha 41, Beta 41 and Gamma 41. Their viscosities were determined by A.S.T.M. D-2 Subcommittee V on viscosity. The official values assigned to them are as follows:

	Alpha 41	Beta 41	Gamma 41
Kinematic Viscosity			
Centistokes at 100°F.	58.22	383.7	3.032
Centistokes at 122°F.	....	182.7	....
Centistokes at 210°F.	7.68	23.87	....
Saybolt Universal (by conversion)			
Seconds at 100°F.	269.2	1773	36.1
Seconds at 210°F.	51.3	114.9	....
Saybolt Furol (by conversion)			
Seconds at 122°F.	....	86.6	....

The kinematic viscosities were determined by a number of laboratories using different types of viscosimeters, however, in each case distilled water was used as a basis of comparison. The Saybolt Universal values were obtained by conversion using A.S.T.M. method D446-39. The Saybolt Furol value was obtained by conversion by the proposed method for conversion of kinematic viscosity to Saybolt Furol viscosity approved by A.S.T.M. in June, 1941.

Recommended procedures for the calibration of viscosimeters have been published by A.S.T.M. in methods D445-39T and D88-38 for the kinematic and Saybolt viscosimeters respectively.

The oil standards are available at $5.00 for quart sample and $2.50 for half-pint sample. Orders for samples should be sent to Dr. T. G. Delbridge, chairman, 3144 Passyunk Avenue, Philadelphia, Pa., with check drawn exactly that way.

Industry Has Best Year of Low Frequency of Accidents

Injuries among 327,112 oil-company employes included in the American Petroleum Institute's annual summary of injuries occurred at the rate of 11.59 injuries for each million hours worked during 1940, thus establishing the most favorable injury-frequency rate since accident records have been kept.

Injury-severity rate of 1.44 days lost for each thousand hours worked was only slightly higher than the low severity rate established in 1939. Most gratifying accomplishment is the new low fatality rate for reporting companies of 30.9 fatalities among each 100,000 employes during the year.

The Institute made awards for 45 individual records to department and subdepartment employes who worked 1,000,000 hours or longer without a disabling injury. One award was made to Baton Rouge refinery of Standard Oil Company of Louisiana for 4,216,600 injury-free work hours. Mechanical division of the refinery, pipefitters, boilermakers, welders, laborers, masons, electricians, carpenters, painters, machinists and other maintenance forces, recently established a record of 5,593,000 hours without a disabling injury. Although this is the outstanding record reported to the Institute, many departments in other companies are making records of more than 1,000,000 injury-free hours and some departments are exceeding their own records previously established.

Fifty A.P.I. certificate awards have been presented to oil companies for outstanding records in accident prevention during 1940. Awards were made on basis of low injury frequency, low injury severity and low injury index (combination of injury frequency and injury severity).

Saybolt Retires as Penola President

J. Walter Saybolt, president of Penola, Inc., resigned August 1. He was a director of Standard Oil Company of New Jersey, vice president of Esso, Inc., and vice president of Standard Oil Company of Pennsylvania.

He entered the oil industry as a helper in the laboratory of Standard Oil Company of New Jersey at Bayonne. Later he entered sales work, first as a special lubrication salesman in West Virginia. Then he became manager of lubricating oil sales for the southern division with headquarters at Baltimore. He moved to New York headquarters in 1924 to take charge of lubricating oil sales for the New Jersey company and in time directed sales for Standard Oil Company of Pennsylvania, Standard Oil Company of Louisiana, Colonial Beacon Oil Company and Penola, Inc. He became president of the latter in 1936.

Henderson Vice President Of Gulf Oil Corporation

Herbert Henderson, general manager of the engineering department of Gulf Oil Corporation, has been elected a vice president and to a similar position with Gulf Refining Company. He joined the company in 1907 and organized the engineering department at Port Arthur. He was transferred to Pittsburgh headquarters in 1928, where he continued in charge of the work.

HERBERT HENDERSON

Defense Demands in Oil Are Mounting

The prospect for still greater demands upon the petroleum industry in the national defense program was made plain at the annual meeting of the National Petroleum Association, Atlantic City, September 17, 18 and 19. Ralph K. Davies, deputy petroleum coordinator, put it in these words:

"It would be a bold man, indeed, who would forecast that the end of the demands to be placed on the petroleum industry of the United States was anywhere in sight. And one must be a still bolder prophet to foretell exactly what must be done by this industry to cope successfully with these twin problems of increasing demands for oil products and decreasing supplies to produce them."

All officials of the association were re-elected: N. H. Weber, The Pure Oil Company, president; C. L. Suhr, Pennzoil Company, executive vice president; H. A. Logan, United Oil Company, vice president; Herbert G. Eaton, Superior Oil Works, recording secretary; G. B. Hunter, Quaker State Oil Refining Company, treasurer; Fayette B. Dow, counsel; Harry S. Elkins, traffic attorney; Hornace L. Lohnes, attorney; M. C. Mallon, attorney.

With the exception of Paul Ryan, National Refining Company, who resigned following injuries in an airplane accident, all trustees were re-elected, as follows: John A. Beck, Pennsylvania Refining Company; Paul G. Blazer, Ashland Oil & Refining Company; Wilbur Burt, Socony-Vacuum Oil Company; H. M. Carruth, Canfield Oil Company; Sheldon Clark, Sinclair Refining Company; Earl M. Craig, Freedom Oil Works; C. M. Davidson, Standard Oil Company of New Jersey; C. E. Foster, Cities Service Oil Company; W. V. Hartman, Gulf Refining Company; W. T. Holliday, Standard Oil Company of Ohio; G. B. Hunter; Otto Koch, Kendall Refining Company; C. J. Leroux, Valvoline Oil Company; H. A. Logan; Noel Robinson, South Penn Oil Company; R. E. Ryerson, Tide Water Associated Oil Company; W. W. Scott, Wolf's Head Oil Refining Company; Charles L. Suhr, and N. H. Weber.

Honorary trustees re-elected are: O. P. Keeney, Wolf's Head Oil Refining Company; Samuel Messer, Quaker State Oil Refining Company; E. M. Lyons, Philadelphia; William M. Muir, Warren, Pennsylvania; R. A. Wotowitch, New York.

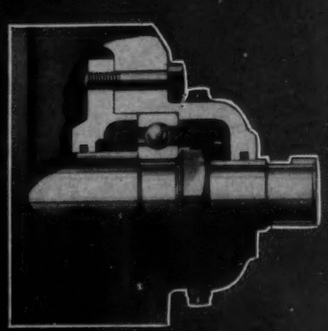
Davies stressed the need for expansion of refining facilities, especially that for making aviation gasoline in addition to taking the oil companies to task for their failure to stress the reality of the East Coast oil shortage.

With one or two exceptions, Davies asserted, the oil companies have failed to assist the coordinator in stressing the reality of the East Coast oil shortage, which certainly exists although various steps have been taken that have made up more than half of the original transportation deficiency of 350,000 barrels per day.

Insufficient stocks exist on the Atlantic Seaboard, which constitute a shortage, Davies pointed out. More of the oil companies should inform public opinion on this matter, and thus eliminate the confusion and uncertainty on the subject.

The industry also faces the fact that

Standard



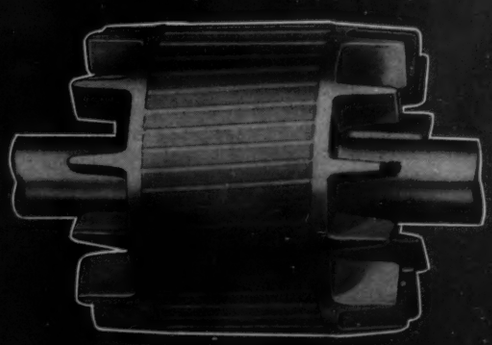
Louis Allis Standard Open Squirrel Cage Polyphase motors are simple in construction—ruggedly built—and are designed for a life-time of dependable trouble-free performance on the toughest jobs.

The rigid one-piece heavy cast iron housing prevents tortion and assures even air gaps, and a well balanced smooth running motor under most severe operating conditions.

Full-size precision bearings and one-piece, dynamically balanced, pressure cast rotor are additional quality features of this motor.

There is a size and type Louis Allis squirrel cage motor for every industrial need.

Write for copy Bulletin 505 fully describing and illustrating the construction features of Louis Allis Squirrel Cage Motors.



THE LOUIS ALLIS CO., MILWAUKEE, WIS.

its total effective refining capacity is crowded almost to the limit, Davies continued. Excess capacity shown statistically is deceptive because for the most part it consists of old equipment which would require extensive alteration in order to produce products to meet modern requirements. Particularly necessary, he said, was the expansion of capacity for making 100-octane gasoline at a rate double the present level. The coordinator's office is working to secure materials for aviation gasoline units, arrange loans for construction and secure contracts to market the gasoline.

The manufacture of 100-octane aviation gasoline must be expanded, declared W. W. Gary, director of refining for the Office of Petroleum Coordination.

One of the critical problems resulting from the war is that of priorities for materials for maintenance of existing equipment and construction of new plants, Gary stated. Thus far, he continued, applications for preference ratings to secure materials used in maintenance have been delayed by an enormous volume of such applications; but OPM recently adopted a revised system of handling these which should go far in alleviating the present critical situation. OPM and the petroleum coordinator are working together on the problem of providing a broader priority rating to the industry to assure continuous operation.

Because of limited supplies of steel and heavy demand, Gary asked that the industry take all possible steps to avoid expansion of unneeded refining facilities. Modification of existing equipment rather than new construction should be tried first.

However, Gary saw one phase of refining in which great expansion is imperative. That is production of 100-octane gasoline. Due to rising demands of American, British and Russian military aviation, the possibility exists that present output of this fuel may have to be doubled. The five district committees on refining have set up subcommittees to study the present output and methods of raising it. Each refinery has been asked to submit a plan specifying its potential production of raw materials going into 100-octane fuel and describing limitations of such production. Plans are being considered to protect refiners installing aviation gasoline equipment against investment losses resulting from possible later shrinkage of aviation gasoline markets, and a general announcement of policy on this matter may be made soon.

British requirements of ordinary motor fuel are being met successfully, according to William Piercy, economist and British government oil representative, who spoke to the association September 18. However, he asserted lubricant needs are not met so easily and specifications for these have been altered to permit American suppliers to meet requirements. Lubricant consumption is not much more than what it was before the war, the increased use by military forces being compensated by reduced consumption by civilian population.

There has been a marked increase, Piercy pointed out, in requirements for 100-octane aviation fuel, as a result of expansion of the British air force and prospect of supplying Russian requirements. This is a major problem, and will increase in magnitude.

In analyzing the possibilities of chemicals from petroleum Dr. Gustav Egloff, research director of Universal Oil Products Company, pointed out that the industry should have time for adjusting its facilities before being expected to fulfill requirements. He said the nation could use three or four times the 100,000,000 gallons of toluol, which has been requested and that the industry could supply it but would need time for installing equipment for its manufacture.

"We are geared too low in our output of synthetic rubber," he pointed out after setting production at 12 percent of consumption. "We are using," he added, "rubber at the rate of 1,000,000 tons a year, compared with 600,000 tons in peacetime. The supply in storage is sufficient for six months and supplies for another three months are en route."

He estimated that an expenditure of $500,000,000 would be necessary for building sufficient plant capacity for providing all rubber requirements at the present rate of consumption.

Other products mentioned in his discussion were picric acid, phenol, methanol and ethyl alcohol, all of which are being manufactured and in most instances output is being raised through plant expansion.

N.G.A.A. Gas Testing Committee Announced

Members of another technical research group of the Natural Gasoline Association of America, the Gas Testing Committee, have been announced by Ray E. Miller, Hanlon-Buchanan, Inc., president of the association.

H. L. Oder, Cities Service Oil Company, Bartlesville, is chairman and S. M. McAnelly, Lone Star Gasoline Company, Ranger, Texas, is vice chairman. Other members of the committee are: H. H. Beeson, Sabine Valley Gasoline Company, Shreveport; J. G. Burnham, Shell Oil Company, Tulsa; P. M. Childers, Continental Oil Company, Ponca City; D. L. Clark, Parade Gasoline Company, Overton, Texas; R. H. Clark, Phillips Petroleum Company, Bartlesville; Paul C. Coffin, The Shamrock Oil & Gas Corporation, Amarillo; D. L. Edmondson, Lisbon Gasoline Company, Henderson, Texas; J. S. Feroe, Hanlon-Buchanan, Inc., Tulsa; W. F. Fulton, United Gas Pipe Line Company, Shreveport; F. E. Huff, Standard Oil Company of California, San Francisco; Fred F. Ketchum, Owens, Libbey-Owens Gas Department, Charleston; A. C. Lankford, The Carter Oil Company, Tulsa; A. Lucas, Skelly Oil Company, Carter Nine, Oklahoma; H. E. Means, Coltexo Corporation, Monroe; John Middleton, Mid-Co Gasoline Company, Malakoff, Texas; E. M. Parkin, Glacier Production Company, Cut Bank; Clegg Perry, Warren Petroleum Corporation, Tulsa; Norman K. Rector, Glen Rose Gasoline Company, Tulsa, and C. H. Smith, Kansas Power & Light Company, McPherson, Kansas.

This committee has an unusually heavy work agenda this year, according to Miller. Among the projects planned is one concerned with studies of high-pressure gases with a view to possible standardization on methods of testing and measurement. A new method for determining the specific gravity of such gases is already under consideration and experiments are being made with several new methods for determining the activation of charcoal used in testing natural gas for its gasoline content.

Bureau Estimate Tops All Former Figures for October

Topping the 4,000,000-barrel mark for the first time in the history of the domestic industry, the required demand for oil in October will be 4,012,900 barrels a day, it is forecast by the Bureau of Mines.

The anticipated demand will be 52,900 barrels above the estimate for September and 11 percent above actual demand in October, 1940, it was said.

Holding that, under present conditions, stocks of all oils are not excessive, the bureau foresaw the need for greater-than-normal additions to gasoline stocks this winter as a safeguard against the overloading of refinery capacity next year.

Daily average crude production for the four weeks August 9 to September 12 was 3,937,000 barrels and total runs to stills 3,990,000 barrels, while domestic stocks declined on an average of 134,000 barrels a day, indicating a demand for domestic crude of 4,071,000 barrels, it was pointed out.

"In the bureau's forecast for October," it was explained, "consideration has been given to continuation of reduced exports from the Pacific Coast, to a possible increase in new means of transport to the East Coast, and to increasing naval requirements for fuel oil.

"The increase of 16 percent in total motor-fuel demand in July, 1941, as compared to last year, was abnormal, due to both the unusually low figure for July, 1940, following inflated sales in June, 1940, and to unusually large sales this year in anticipation of a possible shortage in the East Coast district.

"The bureau's forecast for the fourth quarter of 1941 indicates runs to stills at a probable level of 3,950,000 barrels daily and a demand for domestic crude petroleum of about 4,000,000 barrels daily.

"Under present conditions, stocks of all oils are not excessive. Some increase in crude stocks seems to be desirable after the heavy liquidation in recent months. The seasonal increase in gasoline stocks during the coming winter months might well be greater than normal as increasing demand may otherwise tax refinery capacity during the summer of 1942."

The bureau reported that, on a revised basis, total stocks of all oils in the East Coast district amounted to 70,300,000 barrels on July 31, or about 6,500,000 barrels less than the comparable figure for last year. The estimated increase during August was about 1,800,000 barrels, compared to an increase of 3,100,000 barrels in the same month in 1940.

Domestic demand for motor fuel in October is estimated at 59,700,000 barrels, an increase of 11 percent over the October, 1940, actual demand. Exports, on the basis of forecasts by the principal shippers, are placed at 2,000,000 barrels, exclusive of re-exports of motor fuel imported in bond.

Stocks of finished and unfinished gasoline amounted to 84,701,000 barrels on July 31, and API statistics indicate a decline of about 5,100,000 barrels during August, which would leave approximately 79,600,000 barrels in storage at the close of that month. A further decrease of 700,000 barrels is estimated for October.

Benzol production and direct sales of

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natural gasoline are figured at 1,700,000 barrels, making an indicated refinery production of 59,300,000 barrels, allocated among the several districts as follows:

East Coast, 7,350,000 barrels; Appalachian, 2,310,000 barrels; Indiana-Illinois, 12,510,000 barrels; Oklahoma, 3,060,000 barrels; Kansas-Missouri, 3,370,000 barrels; Inland Texas, 3,860,000 barrels; Texas Gulf Coast, 14,910,000 barrels; Louisiana Gulf Coast, 1,920,000 barrels; Inland Louisiana - Arkansas, 1,170,000 barrels; Rocky Mountain, 1,600,000 barrels; California, 7,240,000 barrels.

Natural gasoline to be blended at refineries was es imated at 8.1 percent of total refinery production, or 4,820,000 barrels; and the yield of straight-run and cracked gasoline was estimated at 44.4 percent which, applied to the production of 54,480,000 barrels, gives crude runs of 122,700,000 barrels, or 3,958,000 barrels a day.

The estimate for foreign crude runs to stills is 4,500,000 barrels, exports are placed at 4,200,000 barrels (compared with 5,269,000 barrels actually exported in October, 1940), and crude to be used as fuel and losses is 2,000,000 barrels, giving an estimated demand for domestic crude of 124,400,000 barrels for the month, or 4,012,900 barrels daily.

Repair and Inventory Priorities Simplified

In an effort to simplify purchase of equipment for plant repairs and for maintaining emergency inventories in 20 industries, among them petroleum refining, production and transportation, Donald M. Nelson, Director of Priorities, has issued Preference Rating Order P-22, which gives these industries a rating of A-10. The order, effective September 9, takes the place of Maintenance and Repair Order of August 8, which never was put into effect.

The new plan is a simplification of the previous order. It provides means whereby under priority status for repair work in specified industries is assured so equipment can be had promptly. Part 1 of the order applies to definitions and listings of the industries to which the order applies.

Text of the order as to its workings follows:

"Material" means any commodity, equipment, accessories, parts, assemblies, or products of any kind.

"Repairs" means only repairs needed because of an actual or imminent breakdown, from whatever cause, of a producer's property or equipment.

"Emergency inventory" means minimum inventory of material required to provide for repairs to meet an actual or imminent breakdown, from whatever cause, of a producer's property or equipment.

"Supplier" means any person with whom a purchase order or contract has been placed by a producer or any supplier for material to be used for repairs; material required for a producer's emergency inventory; material to be physically incorporated in other material which is to be used for repairs or which is required for a producer's emergency inventory.

Assignment of Preference Rating: Subject to the terms of this order, Preference Rating A-10 is hereby assigned to deliveries to a producer of material required by him for repairs or for his emergency inventory; to deliveries to a supplier of material which is, in turn, to be delivered to a producer for repairs or for his emergency inventory or to be physically incorporated in material to be so delivered.

Persons Entitled to Apply Preference Rating: The preference rating hereby assigned may be applied by a producer; a supplier, provided that he requires the material so purchased in order to make deliveries duly rated.

Application of Preference Rating: A producer in order to apply the preference rating to a delivery of material to him must endorse the following statement on the original and all copies of the purchase order or contract for such material signed by a responsible official duly designated for such purpose by such producer:

> "Purchase order for repair or emergency inventory-preference rating A-10 under preference rating order P-22."

Such endorsement shall constitute a certification to the Office of Production Management that such material is required for the purposes stated therein. Any such purchase order or contract shall be restricted to material the delivery of which is rated in accordance herewith.

A supplier in order to apply the preference rating to delivery of material to him must endorse the following statement on the original and all copies of the purchase order or contract for such material signed by a responsible official duly designated for such purpose by such supplier:

> "Purchase order for material required to fill a duly rated order for repair or emergency inventory. This purchase order bears preference rating A-10 under preference rating order P-22."

Such endorsement shall constitute a certification to the Office of Production Management that such material is required to fill an order placed by a producer or supplier duly rated in accordance herewith. Any such supplier's purchase order or contract shall be restricted to material the delivery of which is rated in accordance herewith.

A producer or supplier placing any such rated purchase orders or contracts and the supplier selling the material covered thereby, must each retain endorsed copies of such purchase orders or contracts segregated from all other purchase orders or contracts for a period of two years from the date thereof for inspection by authorized representatives of the Office of Production Management.

Restrictions on Application of Rating: The preference rating hereby assigned shall not be applied by a producer to obtain material in excess of his requirements for repairs or for his emergency inventory; unless the material to be delivered cannot be obtained when required without such rating; by a supplier to obtain material in excess of the amount necessary to make rated deliveries.

False Statements and Penalties: Any person who applies the preference rating hereby assigned in wilful violation of the terms and provisions of this order, or wilfully falsifies records required to be kept or information to be furnished pursuant to this order, or who obtains a delivery of material by means of a material and wilful misstatement will be prohibited from further applying said rating. Such person may also be prohibited from obtaining further deliveries of material under allocation and be deprived of any other priorities assistance. The director of priorities may also take any other action deemed appropriate, including the making of a recommendation for prosecution under Section 35A of the Criminal Code (18 U. S. C. 80).

Revocation or Modification: This order may be revoked or amended by the director of priorities at any time in whole or in part or in its application to any producer or any supplier. In the event of revocation, or upon expiration of this order, deliveries already rated pursuant to this order shall be completed in accordance with said rating, unless the rating has been specifically revoked. No additional applications of this rating to any other deliveries shall thereafter be made by any producer or supplier affected by said revocation or expiration.

Advisory Committee for Canadian Gasoline

Executives from seven refining concerns have been named members of an advisory committee to assist the Canadian oil controller and the minister of munitions and supply. The members are A. L. Ellsworth, British-American Oil Company; P. M. Fowlie, Shell Oil Company of Canada; John Irwin, Canadian Oil Companies; R. Rosenfield, Goodrich Refining Company; G. Harrison Smith, Imperial Oil Company; J. J. Shafer, Sun Oil Company, and J. A. Wales, McColl-Frontenac Oil Company.

Additional Exhibits for Photograhic Salon

In addition to the showing of prints at the second petroleum industry photographic salon in connection with the annual meeting of the American Petroleum Institute in San Francisco, November 3 to 7, arrangements have been made for a second showing which will be open to the public November 10 to 16 in the Doheny library of the University of Southern California.

The prints will be on display in the Museum of Science and Industry, Chicago, from November 22 to December 15. Next they will be at the New York Museum of Science and Industry, December 20 to January 9, 1942. Additional exhibitions may be arranged.

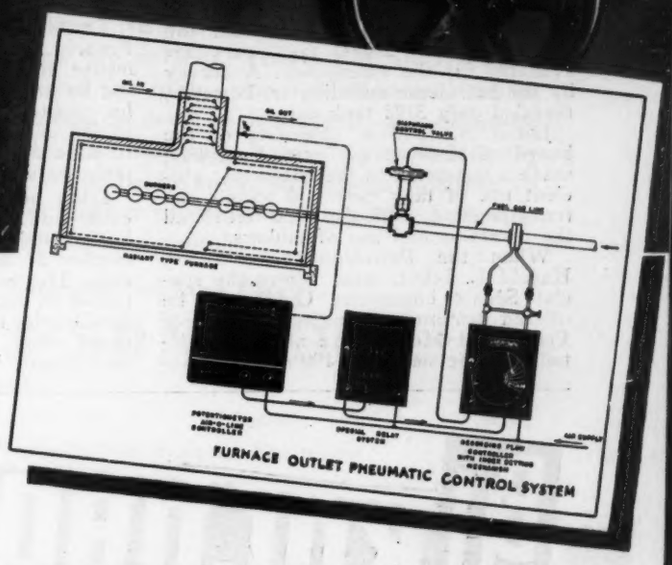
Final day for entering prints is October 17.

Emulsions and Foams

Two chapters of the book "Emulsions and Foams," Reinhold Publishing Company, 330 West Forty-Second Street, New York, are devoted to petroleum refining. The book is the work of Sophia Berkman and Gustav Egloff of Universal Oil Products Company, Chicago.

Under the general subject of practical knowledge of emulsions, one chapter is devoted to "Asphalt and Bitumen Emulsions" and another to "Lubricants and Lubricating Oil Emulsions." The chapters on "Emulsification" and "Demulsification" as well as that on laboratory methods of examination of emulsion are of special interest to the chemists of the petroleum industry.

The volume is priced at $8.50.



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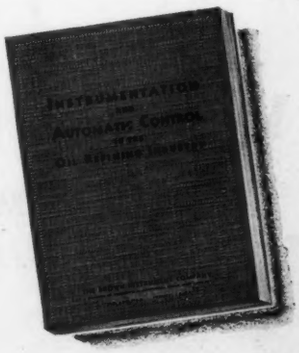

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TO MEASURE AND CONTROL IS TO ECONOMIZE

Washington Roundup

TRANSPORTATION difficulties in supplying both crude oil and refined products to the Atlantic Seaboard kept petroleum circles in Washington in a boiling stage over the last month. Chiefly the controversy was over the availability of tank cars to make up the 174,000 barrels of needed daily deliveries to the area.

After hearings on the question of a pipe line from East Texas to the Atlantic Seaboard an opinion was given to the effect that steel is not available for the line. Previously a special Senate committee had made a preliminary report to the effect that no actual shortage of products exists but rather a "shortage of surplus."

J. J. Pelley, president of the Association of American Railroads, told the committee that 20,000 tank cars are available for the emergency. A survey by the petroleum coordinator, however, revealed only 5192 tank cars.

James A. Moffett, chairman of the board of California-Texas Company, made a statement to the effect that efficient use of tank cars will handle the transportation difficulty and criticized the diversion and use of tankers.

When the Petroleum Coordinator, Harold L. Ickes, came before the special Senate committee October 1 he offered testimony counter to that of Pelley and Moffett. He also gave details on the need for 100-octane gasoline to the effect that the refining industry of the United States must build capacity to furnish 120,000 barrels of this product daily, triple present output.

At his own request, Ickes appeared before the special Senate committee October 1 and charged that the preliminary report of the committee had "gravely handicapped" his conservation program.

He attacked Pelley, classing the railroad man as a "lobbyist whose chief concern was to prevent the building of a pipe line." Further he said that the 20,000 tank cars which Pelley has designated as available for transporting crude oil to the Atlantic Seaboard, can not be found.

To this part of the testimony Senator Francis Maloney, chairman of the committee, rebuked the coordinator by saying he had confidence in Pelley, whom he credited with being the only party to the controversy who has from time to time made progress reports on the tank car situation.

Ickes testified that his department could find but 5192 idle tank cars. Pelley insisted that on the morning of September 27 there were 18,331 idle tank cars. The committee chairman cited a report of the transportation committee for District 1, in which one concern had listed 6640 tank cars available. The coordinator is now making a check on idle tank cars and will file it with the committee.

James A. Moffett charged by public statement October 3 that efficient use is not being made of tank cars, which he classed as capable of relieving the shortage on the Atlantic Seaboard. He said that in 1917, 57,000 tank cars moved 30,500,000 tons of oil, while in 1940, 148,000 tank cars moved only 60,000,000 tons, and added:

"If we were now doing only as well as we did in 1917 we would be moving 80,000,000 tons a year, which would mean an additional 383,000 barrels daily.

Moffett also criticized the diversion and current use of tankers saying:

"We now have a threatened, and probable, shortage on the Pacific Coast for the reason that in withdrawing tankers from the American operators to meet the requirement of the British, the Pacific Coast owners and operators were obliged to contribute a greater percentage of their original tonnage than the East Coast operators and, on top of this, were obliged to load other ships for aid to Russia, with the result that the Pacific Coast operators have contributed 38 percent of their total tonnage to war-aid purposes, while the Atlantic Seaboard operators contributed but 18 percent," he declared.

"It seems to me that it is more important to maintain fuel supplies on the Pacific Coast than on the Atlantic Seaboard in view of the fact that the main part of the American fleet is stationed in the Pacific and the general political situation existing in that area. I am convinced that there has been ample time since April to put the tanker operation and the supply position on a highly efficient basis and, such being the case, that the tankers loaned to the British can be and should be gradually returned to the American operators. I believe that at least six ships can and should be withdrawn from the shuttle service for the Pacific Coast alone and that other tankers gradually can be withdrawn to supply the Atlantic Seaboard's domestic requirement.

"I further believe if we are to secure the utmost efficiency that a division of authority pertaining to tanker operation is bad and that Admiral Emory S. Land and the Maritime Commission know more about ships and the operation of ships than the Petroleum Coordinator's division, and I, therefore, feel that the Maritime Commission should have full authority in respect to the allocation and operation of tankers and there should not be the division of authority as is the case today between the Maritime Commission and the Office of the Petroleum Coordinator. I further feel that London should not have full control over foreign-flag ships which are owned 100 percent by American corporations, as it may be found that some ships are carrying supplies to other markets less important than the transporting of supplies for the consumption of the United States and the United Kingdom.

"In connection with the controversy over the construction of a pipe line from Shreveport to New York, I hope that this is finished once and for all. As Admiral Land stated in his testimony at the hearings of the special committee of the Senate, barges can be constructed with much less steel than would be required for the construction of the pipe line and would make an equal amount of deliveries to

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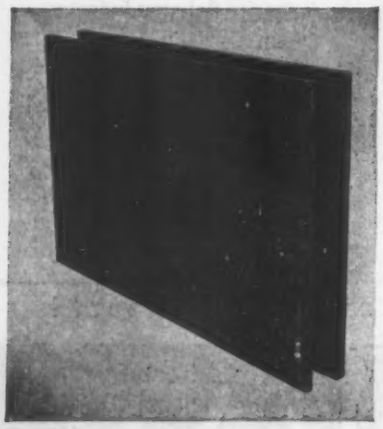

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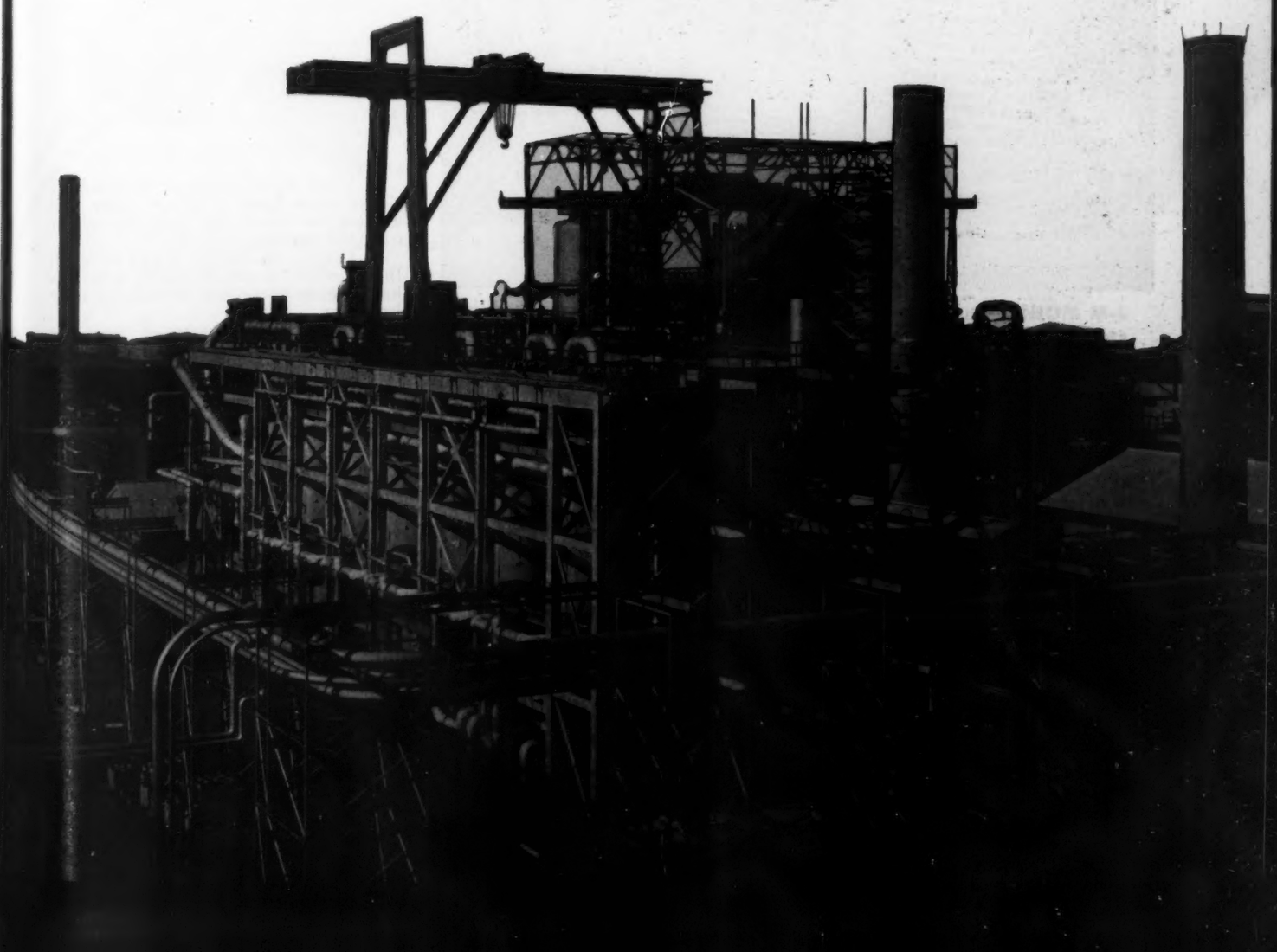

the New York harbor and Philadelphia terminals, and in shorter time."

The petroleum coordinator came before the committee after several weeks of controversy over the tank car situation and the management of the program on the Atlantic Seaboard. Earlier the committee had made a preliminary report to the effect that the area has a "shortage of surplus" rather than a shortage of petroleum products. Later the pipe line proposed from East Texas to the eastern seaboard failed to get a priority rating and Pelley gave testimony to the effect that 20,000 idle tank cars could make up the shortage of 174,000 barrels daily.

Ickes attacked the testimony of Pelley at length and while he admitted that Ralph Budd, chief of the transportation division of OPM, agreed with the railroad man at the time as to the availability of tank cars, asserted that Budd has since changed his position and now agrees with the coordinator's office.

That there are no cars available, he declared, was demonstrated by the efforts of Cities Service Oil Company to secure 1000 additional cars, which resulted in firm offers only for 160 cars.

"So there you have a drama in three acts," he said:

"Act I—Mr. Pelley blithely assures you that he can snap his fingers, and—presto—20,000 cars will be whisked onto sidings in the oil fields.

"Act II—An actual survey among owners of more than 147,000 cars shows that 5192 cars—not 20,000—are claimed by their owners to be available if they can be located.

"Act III—A major oil company asks for 1000 cars—not 5192—and can get only 160.

"I submit that this is not funny. Your committee has issued a report which has gravely handicapped the program of the petroleum coordinator's office, and the major findings of that report were predicated in large measure upon the so-called 'studied opinion and serious promises' of a man who has now been proven to have given testimony which was utterly without foundation—and I believe he knew it was without foundation.

"The mischief which this man has done is incalculable, and I say this entirely without personal consideration.

"Mr. Pelley is an old hand at conniving to stifle any and all competition for the railroads," he charged. "His efforts to wreck the oil trucking business in the Southeast were paralleled more recently by his attempt to block two petroleum pipe lines in the same region. Mr. Pelley was not even embarrassed when he admitted openly that his lobby successfully blocked the construction of the Plantation and Southeastern pipe lines until the Congress enacted the Cole Act, which overcame obstructions to rights-of-way.

"Yet when Senator Maloney asked him whether the railroads were opposing construction of the proposed crude-oil pipe line from Texas to the East Coast, Mr. Pelley managed to keep a straight face as he replied that he did not know of any such opposition."

Strongly supporting the testimony given by Deputy Davies in his appearances before the committee, Ickes declared the cold facts about the situation are:

1. Not enough oil is now moving to this coast to supply all of next winter's already-known needs.

2. Not enough oil is moving to this coast to supply, in addition, almost certain increases in this need.

3. Not enough stocks are available in storage tanks on the East Coast to make up all of the difference between what we will need and what we will move in.

These facts, he said, are known, because:

A. Total stocks on hand on the East Coast have been running under the amount on hand last year by about 6,000,000 barrels.

B. Despite the smaller stocks on hand, the demand for all petroleum products has already increased 10 percent over last year.

C. The total amount of available transportation capacity now actually carrying oil to the East Coast is less than last year as a result of the assignment for defense purposes of a substantial part of this capacity normally used to haul oil to the East Coast.

D. The total volume of oil necessary for the East Coast in the winter is greatly in excess of summer needs since in the winter a heavy demand for domestic and industrial heating oils is superimposed upon a need for gasoline that declines only slightly.

"I have said that there was a shortage—and I mean as I have always meant, a shortage in transportation. I still say that there is a shortage."

Outlining other problems of his office, the coordinator went into considerable detail with respect to the situation in aviation gasoline.

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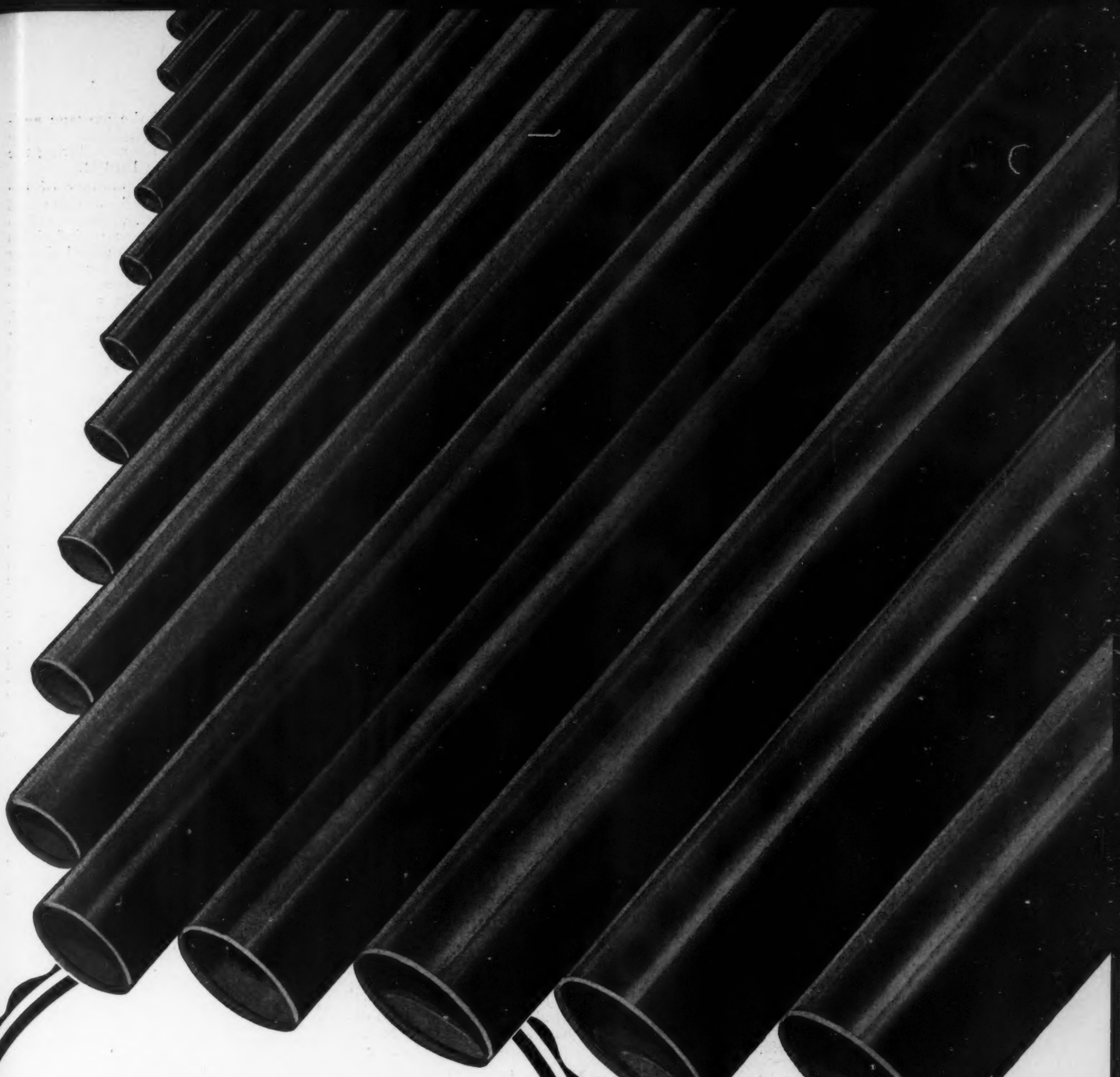

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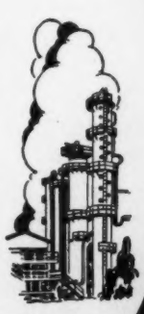

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octane aviation gasoline is 40,000 barrels a day—the largest capacity in the world—but the problem is that of supplying as much as 120,000 barrels a day, he recounted.

"On top of our own needs, we have suddenly had to supply huge amounts of aviation gasoline in our role as the arsenal of democracy," he explained. "These orders, together with our own requirements, have outstripped our capacity. We are drawing too heavily upon our reserves. Likewise, we do not have sufficient capacity for producing the blending agents which must be used in manufacturing 100-octane gasoline.

"I have warned the industry that it must greatly increase its 100-octane capacity quickly. We are working with the industry and with Secretary Jones and the Defense Plant Corporation to evolve a program to construct new refineries for 100-octane. We are also seeking a better control of purchases. But new plants take many months to erect. Meanwhile, we must have gasoline. Mr. Davies told you that the Navy was having trouble in buying fuel oil for its ships and shore stations. I am not happy to tell you that it also has encountered difficulty in obtaining 100-octane aviation gasoline. One week, when the United States Navy, acting as Lend-Lease purchasing agent, asked for bids for supplying 600,000 barrels of aviation gasoline for Lend-Lease purposes, it got no bids. Foreign demand for September, for 100-octane, was equal to our entire American production for that month. Obviously we cannot begin to fill these orders for the nations fighting Hitler and still supply our own needs. And if we don't supply England and Russia, and others that are in our first line of defense, where will they get their 100-octane gasoline?"

Extra War Demand 300,000,000 Barrels

From the estimates of military experts, testimony before committees of Congress and calculations of individuals, the American Petroleum Institute has suggested 300,000,000 barrels per year as the extra demands on the petroleum industry in the national defense program.

Following is part of the digest on the subject:

"Specific needs of the armed forces are not revealed, but a number of overall estimates have been made, ranging from 75,000,000 to 150,000,000 barrels of products annually under maximum war effort.

"An English petroleum expert, apparently basing his estimates on knowledge of the present conduct of the war, believes that the reasonable maximum demand for the United States Navy will be no more than 36,000,000 barrels of diesel and fuel oil, and that for the United States Army might reach 28,000,000 barrels of motor fuel and lubricants, a year. An Army spokesman, however, testifying recently before the House Military Affairs Committee, estimated that maximum war effort would see the Army and Navy using 10 percent of total United States petroleum production, or about 140,000,000 barrels.

"Both of these estimates are exclusive of the demand for aviation motor fuel. The English expert thought that this demand would not rise to more than 11,000,000 barrels a year, while an Army spokesman said that the Army and Navy needs were anticipated at about 1,000,000 gallons daily, or 9,000,000 barrels a year, of 100-octane aviation fuel.

"In addition to these Army and Navy needs for petroleum products, the defense effort unquestionably would increase substantially the demand from industry, transportation, and agriculture, all of which depend on petroleum to a great extent. Assessing of this increased demand is extremely difficult, but it is believed that the maximum extra consumption would not be more than 100,000,000 to 150,000,000 barrels a year. Total gain from all users because of national defense, therefore, would not be more than 250,000,000 to 300,000,000 barrels a year, or an average of 685,000 to 820,000 barrels a day. The American industry normally produces more than one billion barrels of crude oil yearly.

"Present capacity readily can meet these increases for the industry's normal products, and it recently has been expanded to begin the commercial production of defense products outside the industry such as synthetic rubber, toluol, and glycerine. Refining capacity already in operation is capable of producing more than 1,500,000 gallons daily of 100-octane aviation fuel, or 50 percent more than the future maximum Army-Navy demand estimated by the government. However, expansion of this capacity is forecast to assure adequate supplies for other consumption and exports of super aviation fuel.

Gulf Directors Increased to Nine

Three additional directors were added to the board of Gulf Oil Corporation in August, J. E. Nelson, H. A. Gidney and Alan M. Schaife. The three are members of the finance committee of the organization.

Older members of the board are W. L. Mellon, chairman; F. A. Leovy, vice chairman; J. Frank Drake, president; H. L. Stone, Jr., executive vice president and general counsel; M. V. Hartmann, vice president, and R. K. Mellon.

Wilson Elected Panhandle President

Henry Warren Wilson, vice president of W. R. Davis and Company, Houston, has been elected president of Panhandle Producing & Refining Company. He succeeds W. R. Davis, who died in August.

Gasoline Survey Reveals Changes

A comparison of the changes in gasoline specifications over a five-year period is part of the sixth Comparative Fuel Research Motor Gasoline Survey, by E. C. Lane, assistant petroleum chemist, United States Bureau of Mines. The following is a part of the comparison of winter surveys from Bureau of Mines Report of Investigations 3576:

"This being the sixth winter-survey report in the new series of motor gasoline studies it is now possible to make a 5-year comparison of the average antiknock and volatility qualities of the three grades of gasoline sold during the period from 1935-36 to 1940-41.

"The average octane number of the regular-price gasoline has risen 4.8 units, from an A.S.T.M. value of 69.6 to 74.4 during this five-year period. This rise has been more pronounced during the past two winters than for the three preceding winter periods. For the premium-price grade the average octane rating has risen from 76.7 to 80.2, or 3.5 units. A slight decline in average octane number for the winter of 1939-40 was recorded, but otherwise the rise in average has been steady. The average octane number for third-grade gasoline, after a slight decline from 57.9 in 1935-36 to 57.5 in 1936-37, rose steadily from the low of 57.5 to 65.6 for the present survey, a rise of 8.1 A.S.T.M. octane numbers in the last four years. The present third-grade gasoline is now only 4 octane numbers below the regular-price gasoline of 1935-36.

"The change in volatility over the same period is shown by increase in vapor pressure and decrease in the temperatures of the 10, 50, and 90 percent recovered points of the average winter gasolines.

"The average vapor pressure of the regular-price gasolines has not varied more than $\pm$ 0.3 pound from the average of about 10.3. The departure for the present survey is the highest for the period. The average of the premium-price grade has risen from 9.0 to 10.1 pounds, a difference of 1.1 pounds for the period. The average vapor pressure for the third-grade gasoline decreased 0.2 pound for the winter of 1936-37, and then rose from 7.9 to 9.0, a difference of 1.1 pounds.

"The average temperature of the regular-price gasoline for the 10 percent recovered point was 130° F. for the first two winters and has declined to 125° F. for the present survey, a difference of 5° F.; the 50 percent recovered point started at 238° F. in 1935-36, rose 1° F. the next winter, and since has declined to 227° F., a net decline of 11° F.; the 90 percent recovered point has declined from 353° F. to 343° F., a difference of 10° F. The average temperature for the premium-price gasoline 10 percent recovered point has declined from 136° F. to 128° F. for the present survey, a difference of 8° F.; the 50 percent recovered point starting at 223° F. for the winter of 1935-36 rose to 229° F. in 1937-38 and has now declined to 218° F. for the present survey, a net decline of 5° F.; the 90-percent recovered point started at 326° F., rose during the first two winters to 337° F., and then declined to 325° F. for the present survey, a net decline of only 1° F. The average temperature of the third-grade gasoline has declined for the 10-percent recovered point from 144° F. to 136° F., a difference of 8° F.; for the 50 percent recovered point from 254° F. to 240° F., a difference of 14° F.; and for the 90-percent recovered point from 364° F. to 345° F., a difference of 19° F.

Summary

"This survey of motor gasoline sold to the general public through service stations in marketing areas throughout the United States during the winter of 1940-41 is the eleventh that has been published, pursuant to a cooperative

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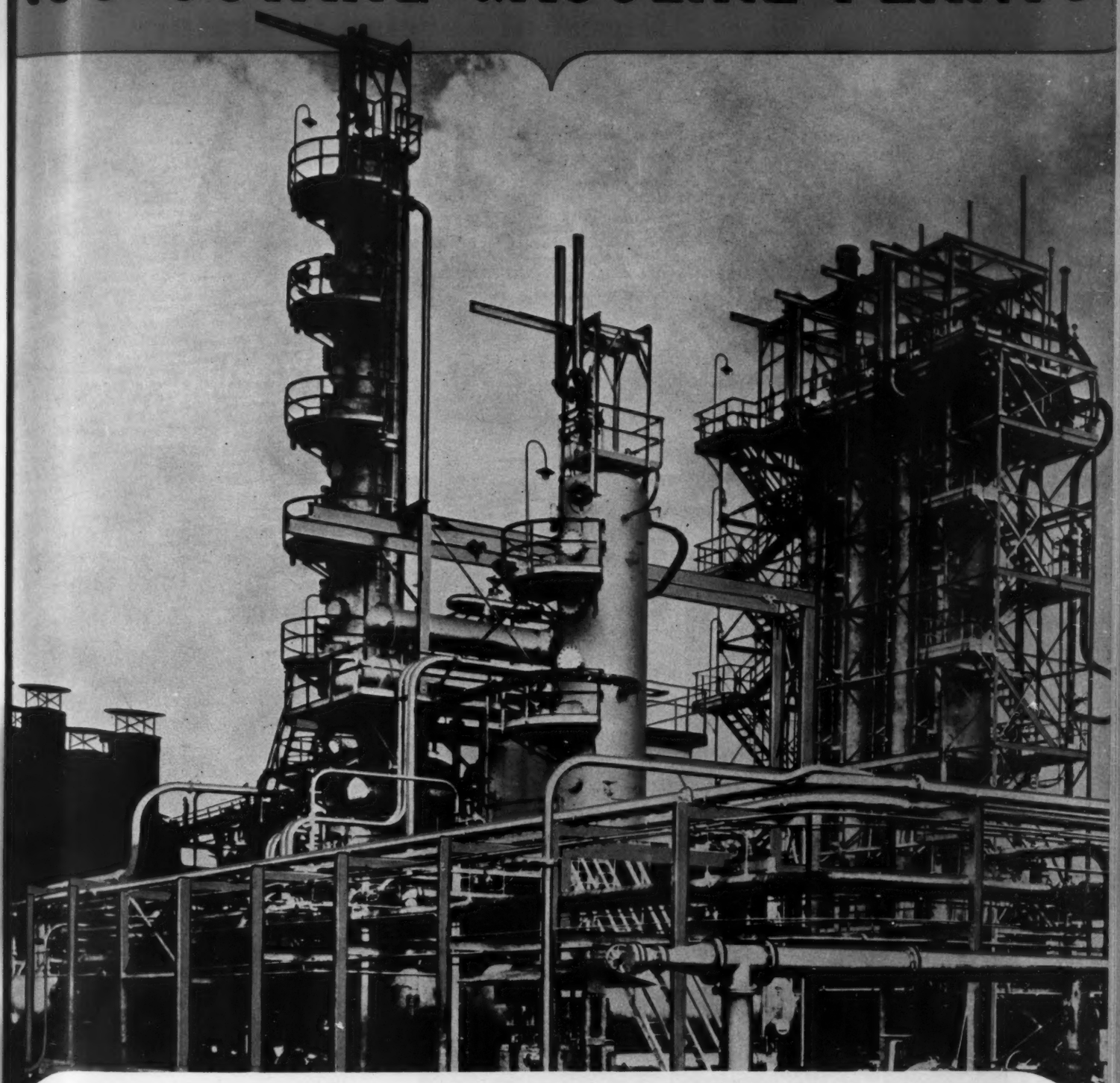

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agreement between the Bureau of Mines and the Cooperative Fuel Research Committee.

"Characteristics of regular-price, premium-price, and third-grade motor gasolines are reported, based upon inspections made in laboratories of contributing companies and submitted to the Bureau of Mines for compilation and comment.

"The eleven surveys in this series indicate that (1) gasolines in the various price classifications generally fall into definite groups with respect to the characteristics reported in the surveys, (2) the differences between these groups are decreasing, and (3) the antiknock and volatility qualities of winter gasolines are increasing rather steadily."

Digest of Foreign Literature

By HEINZ HEINEMANN

Hydrocarbons, Purification, Analysis and Application

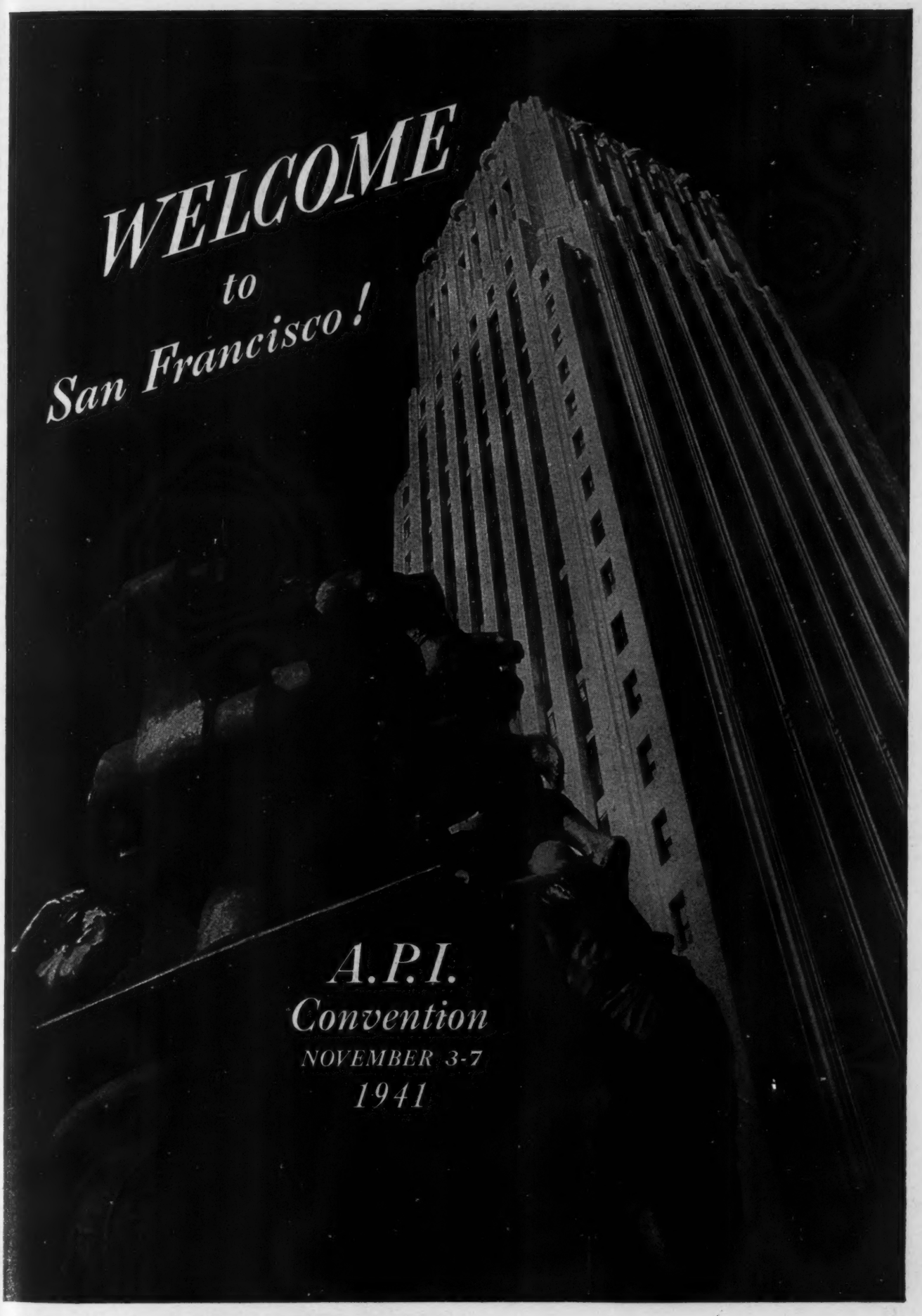
Methods to obtain aromatic hydrocarbons from crude oil and its products occupy the foreign as well as the American literature. In French patent 49244, issued to I. G. Farbenindustrie, it is proposed to obtain pure aromatic hydrocarbons or high octane fuels from gasoline by dissolving the gasoline in propane or similarly low boiling hydrocarbons and extracting with liquid sulphurdioxide at —20 to —80° C. The sulphurdioxide has previously been brought to reaction temperature and no observable change in temperature should occur while mixing it with the gasoline. Elevated pressure favors the procedure.

The removal of paraffins is treated in D.R.P. 671,887, issued to Deutsch Petroleum A.G. Mineral oils are treated with gasoline and sulphuric acid in the cold. The sludge, resulting from such treatment, consists of acid tar and paraffins and is separated in centrifuges which have small holes in the walls to permit the sludge to leave. For smooth operation, small amounts of alkali (less than .5 percent) have to be added before centrifuging.

The desire to know more about the chemical composition of oil, in order to better understand and direct its behavior is expressed in numerous articles on analytical subjects. "Investigations concerning the chemical composition of crude oils" are made by Santilhano and al. (in Chem. Weekblad 38, 106, 1941); In this paper the authors start with the publication of results obtained with crudes of different origin. The investigations are based on the analytical methods by physical tests as proposed by Waterman. (Determination of the degree of cylization and branching of hydrocarbon mixtures by means of the refractive index and the specific parachor). One Roumanian and two Venezuelan crudes were investigated. The crude oils are cut into 9 to 10 fractions by vacuum distillation and the physical constants of each fraction are taken before and after hydrogenation. From these data the number of rings present and the branching of parafin chains are calculated. These results are further supplemented by considering factors like color and viscosity of the fractions. It is promised for a later publication to show a method to differentiate between five and six rings and condensed and single rings.

Another method for the determination of the chemical constitution of mineral oils is described by Vogel in "The Distribution Law at the Extraction with Selective Solvents" (Oel und Kohle 36, 547). Oils are extracted with selective solvents. No separation of the extracted material from the solvent by distillation is necessary, but information on the contents of extract in the extraction layer and of refined products in the other layer is obtained from the weight and specific volume of the oil, the solvent, the extraction layer and the refined layer. A separation theorie for selective solubility is given and based on it the distribution law is applied for concentrated solutions.

B. C. Allibone treats "The Investigation of High-Boiling Petroleum Oils by Adsorption Analysis" (Journal of the Institute of Petroleum Vol. 27, No. 209). The well known chromatographic adsorption of Zechmeister is applied to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the analytical separation of high boiling compounds of petroleum. For this purpose a distillation cut of limited boiling range is dissolved in petroleum ether which is free of aromatics and the solution filtered through a column of adsorbent. Silica Gel is most advantageous. Fresh petroleum ether is added after exhaustion of the primary solution and the filtration is continued until the material recovered from the filter approaches a certain specific gravity. The adsorbent is then dried and divided into several portions according to varying color and the like and extracted with solvents. Distillates as well as residues may thus be separated into a number of components of widely varying physical characteristics.

Also concerned with the chemical structure of oils is an article by U. v. Weber on "Determination of branched isomers in mixtures of paraffin hydrocarbons" (Angewandte Chemie 52, 607). The anti-knock stability of hydrocarbons is largely dependent on their chemical structure. Generally the tendency to knock increases with the molecular weight and decreases with increasing branching of the molecule, whereby the location of these branches is also of great importance. The extent of branching of paraffin hydrocarbons of known medium molecular weight can be approximately determined from the octane number. The reverse method, the direct determination of the branches is advantageous only in such cases in which there are only small amounts available or where it is desirable to observe small changes in the composition of the hydrocarbon mixture. For mixtures consisting of a few components the Raman Spectral Analysis is very suitable. The new method which the author describes permits, however, the determination of the degree of branching in mixtures of many components. Since nearly all isoparrafins boil at least 5° lower than the corresponding n-paraffins, a thorough distillation with a column of 30 to 40 theoretical plates is sufficient to separate all branched paraffins of equal carbon number from the corresponding n-paraffins. The paraffins form ideal solutions with each other. If one plots boiling points against molecular weight and connects the boiling points of the n-paraffins, a characteristic boiling curve is obtained. A comparison with boiling points of i-paraffins shows that every branch in the molecule reduces the boiling point of the paraffin by about the same amount. In a mixture of many components the medium boiling point depression per branch is about 7° C. The fractions from the distillation contain in the worst case hydrocarbons with two different carbon numbers. If one determines the molecular weight and the boiling point of a fraction, the difference between the observed boiling point and the corresponding point on the previously mentioned curve is characteristic for the branching.

Among many articles on various new uses for petroleum products is one by H. D. Lord on "The use of mineral oils as Mosquito Larvicides" (J. Institute of Petroleum, 27, 209, 73). The requisites of an anti-malarial oil to be spread on stagnant or streaming water to prevent breeding of the mosquito larvae are: A fairly high spreading pressure to produce an immediate unbroken film when sprayed on water at a rate equivalent to 4 oz. per 100 square feet. The film produced must remain stable and effective over a long period. The viscosity must be fairly low so that larval trachae are easily penetrated. The oil must not contain very volatile ingredients which on evaporation will leave the film too thick and non-penetrating or cause its segregation into leuses. The oil should possess true toxic properties against larvae, but be nontoxic to fish and birds. This applies particularly to any compounds soluble in water. The oil should be fairly dark in color so that thin films on water are clearly visible. Spreading pressures of all anti-malarial oils tested showed a tendency to increase with time. It is therefore recommended to store the oils for 3 months before use. Sunlight and also irradiation by artificial light have a corresponding influence. Pressure distillate residue is found to be very effective.

Safety and Anti-Knock Fuels

Anti-knock safety fuels for airplane motors are discussed by v. Voorhis (Petroleum 35, 635). It seems that military aviation will use within the next years 24 and more cylinder motors for forced injection of safety fuels. For forced injection a fuel of lower volatility can be used and the danger of inflammation can thus be reduced. Difficulties still exist in mixing air and fuel at the start and when flying at varying altitudes. Customary safety fuels have a boiling range of 160 to 205° C. The self ignition point is higher than that of diesel fuels. To start safety fuel motors gaseous or volatile liquid fuels are required. It has been proposed to construct a small electrically heated cracking unit in the plane in which safety fuel or lubricating oil would be cracked when starting the motor. Size and weight of such unit would be lower than that of special pressure tanks for gases or volatile fuels.

For the gasolines with an octane number of 100 and more new test methods are required. An investigation of aviation fuels with the customary methods shows: irregular knocking with increasing cylinder temperature, increasing knocking with increasing density of the injected mixture, increasing knocking with advancing of spark, difficulties with aromatic mixtures. It is suggested to apply a system of precompression. The use of iso-octane with increasing amounts of tetraethyllead as reference fuel is not satisfactory, because the anti-knock stability increases irregularly. Compounds with a higher octane number than i-octane with 4 cc. of lead have to be used. Aromatic compounds are unsuitable for the plane motor because of their tendency to overheat the cylinder. In a future test motor with preceding compressor the cylinder temperature should be measured besides the knock intensity.

Two Dutch patents (44,160 and 45,-609) to the N. V. de Bataafsche Petroleum Maatschapij mention new anti-knock agents. The one describes the addition of small amounts of hydroselenic acid to the gasoline, while the other uses heavy metal compounds soluble in the oils. These compounds are obtained from metaloxides or -hydroxides, from organic compounds containing hydrogen atoms which can be replaced by metal and from alkyl compounds of nitrogen, phophorus, arsenic, sulphur, selenium, tellurium or esters of acids of these elements.

A. Zscharn describes the "Instability of Tetraethyllead Compounds" (Chemikerzeitung 64, 498). Tetraethyllead compounds can decompose in a dangerous manner. The formerly customary preparation of the compound in a Grignard reaction permitted the possibility of peroxide formation. Such peroxides could not be found, however, but the tetraethyllead prepared from lead and sodium is unstable too. The higher lead alkyl compounds (ethyl-, propyl-, etc.) explode occasionally even when distilled in the vacuum at oil bath temperatures of 160 to 170° C. Violent decompositions have been observed when working with tetramethyllead.

Stabilization of Tetraethyllead is proposed in German patent 681,696 issued to I. G. Farbenindustrie. To stabilize tetraethyllead and anti-knock agents containing it, additions of alkalifluorides are made. The neutral alkalifluorides are added in amounts which surpass the solubility and are kept in suspension for some time at elevated temperatures and the liquid is finally separated from the undissolved parts. The suspension should be boiled on a reflux condenser.

Lubricating Oils

Several articles consider the aging of lubricating oils as characteristic of their qualities. "Laboratory Testing of the Tendency of Lubricating oils to Age" is the subject of an article by F. Jostes and A. Hann (Oel und Kohle 15, 515). The customary testing methods do not permit good insight in the stability of lubricating oils against aging, because they are too dependent on the conditions under which the tests are carrried out. The authors show that the tendency of a lubricating oil to age can only be defined by the time which is required to reach or at least nearly approach a certain point under well defined conditions. Only the Indiana test corresponds to this requirement. After finding that the glass parts used in the equipment have no chemical influence on the execution of the test, the author worked out an improved modification of the Indiana test. This modification permits the use of only 20 cc. of lubricating oil instead of 300 cc. for the original test. The artificial aging is carried out at 200° C. by passing 650 cc. of air per hour through the oil. Observation of the time required to form 15 mg. of asphaltic material per 1 g of oil gives the desired figure. It can be obtained from a chart in which mg asphalt is plotted against time of aging. The data obtained compare well with those of the original Indiana test. Experiments with 10 different oils show that higher temperature and increasing the amount of air shorten the time required for reaching the critical aging point, but do not influence the relative position of the curves to each other.

M. Marder and Tokmitt write on "The Value of Laboratory Methods for the Determination of the Aging Tendency of Lubricating Oils" (Oel und Kohle 14, 615). Results from different test methods for the tendency to age of lubricating oils are hard to compare with each other. Experiments conducted in Noak's apparatus show that the absolute and the relative aging stability of oils are largely dependent on the conditions of the test (temperature, pressure, time). The values obtainable also depend on the quality which is selected as characteristic for the aging stability (asphalt and gum content, viscosity,

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neutralization and saponification number). To get a reliable rule for the aging stability of a lubricating oil it is necessary to either work under the most exerting conditions existing in the motor or to approach conditions which are similar to those prevailing in the motor during normal operation. The first would be required for airplane lubricating oils which have to stand up well under all conditions. The second presupposes a knowledge of the average conditions of aging of oils in the motor which can only be gained after thorough laboratory and road tests.

Catalysis

That sulphur does not necessarily have a bad effect on catalytic processes is shown in an article by O. Fuchs and H. Brendlein on "The Effect of Sulphur on the Catalytic Hydrogenation" (Angewandte Chemie 52, 49). It was formerly believed that ironoxide has no catalytic qualities but acts only to bind sulphur. Varga proved that iron catalyses hydrogenations at 405 to 410° C. In this connection the expression sulphur resistant catalyst was used, in contrast to nickel which is poisoned by small amounts of sulphur.

In the course of experiments it was found that the hydrogenation is activated in many cases by the presence of sulphur. Besides iron and cobalt even nickel could be activated with sulphur. The activity of sulfide catalysts could be increased by the addition of sulphur. Catalyst of certain grain were sulphurized at 380° C. and atmospheric pressure with hydrogensulphide and water in a ratio of 1:1. They were then reduced with a hydrogen-water-vapor mixture (9:1) at 450° C. It was found that the maximum reduction takes place in the beginning and that the sulphur content then slowly approaches a constant value. The sulphur could never be completely removed under these conditions. Sulphurized molybdenumoxide was very stable in contrast to other oxides and oxide mixtures.

In a continuously operating hydrogenation unit simple organic compounds like n-hexanol, benzol, naphthalene were hydrogenated at temperatures of 440-460° C. and pressures of 200 to 300 atmospheres in the presence of sulphur and reduced catalysts. It was shown that the presence of hydrogensulphide (by addition of carbondisulfide) improved and prolonged the hydrogenation effect. This is particularly obvious when using iron catalysts and is explained by the fact that such catalyst are desulphurized by moist hydrogen. Experiment on sulphurized iron catalysts containing aluminumoxide showed that those which obsorb and release sulphur during the reaction are best suitable and that the mechanism of the catalysis is apparently favored by the combined effect of a gaseous and a solid phase of sulphur (e.g., solid sulphur compounds and hydrogensulphide). Benzol was hydrogenated with an ironoxide-aluminumoxide catalyst in the presence of 5 percent carbondisulfide at 460° and 300 atmospheres. In the presence of water the reaction did not start well, while in the absence of water 65 percent cyclohexane were obtained after 2 hours. Naphthalene was best hydrogenated with the same catalyst under equal conditions after the addition of 3 percent elementary sulphur. Ninety-five percent dekaline and tetraline were obtained.

Lubricating—and Heavy Oils

The influence of inhibitors on lubricating oils is studied in an article on "The influence of inhibtors on lubricating oils" by Schildwaechter and Unverhau (Kraftstoff 16, 280). While the effect of adding oxidation-preventing inhibitors to lubricants has so far nearly exclusively been tested with artificial aging methods, the authors compare the effect of such inhiibtors upon the aging of a paraffinic base as well as a naphthenic base lubricating oil in the motor with the effect of the inhibitors upon the same oils during artificial aging as expressed by the improved Indiana test. As inhibitors to the lubricants tetraphenyltin, tinoleate, m-phenylendiamine were used. In Indiana tests at 172° C. (341.6° F.) these materials showed no effect when added in amounts of 0.1 to 0.5 percent. At 150° C. (302° F.) only the oil with a paraffin base showed a distinct effect when containing 0.5 percent tinoleate or tetraphenyltin. It appears that tintetraphenyl preferably inhibits the formation of gum and asphalt, while tinloeate prevents the formation of acids.

The motor tests for these oils were carried out in one-cylinder Otto motors, running a total of 150 hours. After every 50 hours the motor was broken down for corrosion tests, rebuilt and an oil sample tested.

A corrosion preventing effect of the inhibitors could not be found in the

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motor tests. Just as in the artificial aging experiments, the inhibitors did not provoke any change in the viscosity or viscosity-temperature relation. There was, however, a distant oxidation preventing effect of tinoleate in the paraffin base oil, expressed by lower gum and asphalt formation. Tintetraphenyl on the other hand showed no corresponding inhibiting influence on the naphthene base oil in the motor tests.

An important study is made by Matthysen in an article on "The Catalytic Influence of Metals on the Aging of Lubricating Oils in the Diesel Motor" (Oel und Kohle, 36, 308). It is investigated, if and how far metals and alloys, used in the construction of the motor and coming in contact with the lubricants influence their aging. The experiments were carried out in a Mollinger oxidation unit; 100 g of the oil are placed in an iron container and heated to 250° C. (482° F.). At this temperature the oil is distributed into fine droplets by a rotating blade (2800 rev./min.) and thereby contacted with air for 85 minutes.

Metals or alloys in amounts of .3 percent are added to the lubricating oil (paraffin base) in form of a pulver and the oil is then aged in the described manner. The resulting oil is compared with an analysis of the fresh oil and with oil treated in the same manner but without the addition of pulverized metals. It is shown that iron-metals favor aging while non-iron metals have none or a negligible effect. Copper has a negative catalytic effect. This remarkable fact induced the author to study the influence of the temperature on copper admixed oils from 100 to 230° C. Naphthenic base lubricating oils were also investigated to see if the catalytic influence of copper on them is the same as in case of paraffin base oils. It was found that the catalytic influence of copper upon the aging of paraffin base lubricating oils is a different one at low and at high temperatures. At approximately 180° C. the influence changes with increasing temperature from weak positive to distinctly negative. On naphthenic base oils no catalytic influence could be observed. The influence of pressure on the viscosity and the qualities of lubricating oils is studied in an article on "Pressure, Viscosity and Lubricating Qualities" by Kadmer (Kraftstoff, 16, 302). It is stated that the multiplying factor "k" of the viscosity increases with increasing pressure. That the factor k decreases with increasing temperature. That the viscosity-temperature curve flattens out with increasing pressure.

A commercial problem concerning the use of transformer oils is treated by Stanisavlievici in "Investigations on mixtures of transformer oils" (Kraftstoff, 16, 380). In industrial use it is often necessary to refill the insulating oils in transformers with oils of different origin. In order to investigate whether the quality of the oils is influenced by thus mixing them, fresh and used transformer oils from different sources were investigated separately and in mixture.

The critical test applied related to the tendency of mineral oils to form solid deposits. The oils were artificially aged in the presence of a copper spiral and at 115° C. (239° F.). The relation of products insoluble in gasoline which were formed during the test and the heating period was established. The curves thus obtained are characteristic for the aging properties of the oils.

Four fresh oils of similar chemical properties and eight fresh and used oils of not similar properties and of different origin were investigated. Further, tests were made on three mixtures of two oils each of similar properties and on 11 mixtures of two oils each of not similar properties. The curves for the deposit-heating period relation obtained for the mixtures were compared with the curves of the two original oils. It was found that of 14 mixtures, only one corresponded to the quicker aging partner. All other mixtures showed either an intermediate curve between those of the two components or in some cases gave even a better curve than either component alone. This fact is explained as a consequence of the changed percentage of aromatic hydrocarbons and of gum in the transformer oils, which in turn influences the oxidation stability.

The removal of paraffin from mineral oils is the subject of German patent 696,953 issued to the I. G. Farbenindustrie. To remove paraffin from the oil, the oil is dissolved in at least 200 volume/percent of isobutyron at elevated temperatures and the solution is then cooled to at least —5° C. (23° F.). The paraffin flocks out and is filtered.

Catalytic Processes

Studies on the catalytic cracking of paraffins with aluminum chloride are made by Otum (Oel und Kohle, 36, 307). He reports that the gasoline

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fraction obtained increases with the concentration of the aluminum chloride. Some aromatization can also be obtained.

Aromatization of aliphatic hydrocarbons is described in a Dutch patent (49,278, issued to the N. V. de Bataafsche Petroleum Maatschappij). Aliphatic hydrocarbons are sent over an aluminumoxide-chromiumoxide catalyst at 400-600° C., whereby hydrocarbons with six to twelve carbon atoms are readily cyclized. For a particularly good effect, the catalyst should contain 10 to no percent chromiumoxide and alkali in such a proportion that there are 15 to 20 atoms of alkalimetal for every 100 atoms aluminum or chromium.

German Patent 157953 describes the alkylation of hydrocarbons containing a double bond with aromatic or mixed aromatic and alicyclic hydrocarbons, their homologues or substitution products. The catalyst proposed is perchloric acid or a mixture of perchloric acid with other mineral acids like sulfuric or phosphoric acids; a mixture of the alkalisalts of perchloric acid with other minehal acids can also be recommended. While in some cases already 20 to 25 percent of perchloric acid gives good results, a concentration of 60 to 70 percent is generally preferred.

Many patents have recently been issued to I. G. Farbenindustrie on the subject of catalytic hydrogenation. One of the most important is D.R.P. 696364. When hydrogenating asphalts or ashpalt containing oils under conditions destructive hydrogenation the formation of hydrogenrich hydrocarbons which tend to precipitate ashphalts and thus to poison the catalyst has to be avoided. On the other hand, insufficient hydrogenation will lead to undesirable polymerization effects and sufficient hydorgenation effect has therefore to be provided. It is possible to obtain conditions under which both undesirable reactions are avoided, when working at pressures of more than 300 atmospheres and at temperatures of more than 450° C. The catalyst should consist of mixtures of weakly hydrogenating catalysts with an embodiment of smaller amounts of strongly hydrogenating catalysts. As weak hydrogenating catalysts are recommended: the sulfides of iron, manganese, zinc, titanium, copper. As strong hydrogenating catalysts are recommended: the sulfides of molybdenum, tungsten, chromium, uranium, nickel, cobalt, vanadium, tin, rhenium, germanium. The percentage of strong hydrogenating catalysts in the mixture is preferably 3 to 30 percent. Supports like active coal or clay can be used in which case the percentage of the strong hydrogenating catalyst in the mixture should be at least 25 percent. The catalysts are generally provided in solid construction in the reaction vessel, but they can also be dispersed in the charge stock.

The processing of gas oils in order to obtain anti-knock diesel fuels is described in French Patent 850899. The gas oil is treated with selective solvents which separates into hydrogenrich and hydrogenpoor fractions. The fractions poor on hydrogen are hydrogenated without cracking and then again mixed with the hydrogenrich parts. In another form of execution of the process, the hydrogenated fractions are again divided into hydrogenrich and hydrogenpoor fractions by treating with selective solvents. The process is then repeated with the part which is low in hydrogen content.

Various Refining Processes

In a paper on the present and future possibilities of the production of liquid fuels, Franz Fischer (Brennstoffchemie, 22, No. 1) mentions a new isomerization process, recently developed. He says, that the liquid paraffinic hydrocarbons of the Kogasin can be converted into isomers with higher octane numbers at least as far as the lower molecular weight hydrocarbons are concerned. The isomers can be used either for themselves like isopentane or for alkylation purposes as in case of iso-butane. It is still impossible to isomerize higher molecular weight hydrocarbons without some cracking taking place so that a mixture of hydorcarbons of different molecular size results.

The processing of refining residues and the regeneration of refining agents is described in D.R.P. 693150. Acid sludge from the refining of mineral oils with sulfuric acid is heated in an autoclav to 160-180° C. without preceeding dilution with water. Adding compressed air, the pressure is increased to 10 to 25 atmospheres and these conditions are maintained for 2 hours. The mixture is then cooled to 70° C. and the pressure released. Acid and tar now separate easily. The tar is then processed at 150-200° C. with superheated steam and a bitumen of good qualities for road construction is obtained.

Analytical Methods

A new piece of equipment is described in an article on "Determination of Gum Forming Materials in Fuels" (Nashan, Oel und Kohle 36, 349). An improvement of the following process for the determination of potential gum is given. One

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hundred cc fuel are heated on the reflux condenser to boiling and 6300 cc of oxygen are introduced during three hours by means of a glass capillary. The fuel is finally distilled and the residual gum weighed. The total time for the test is five hours. A new automatic distributor is now described which enables a better mixing of the oxygen, the fuel and the vapors. The time of treatment can be reduced to 30 minutes and the amount of oxygen required to half or 3150 cc. Comparative experiments are made with the same fuels and a good analogy to the standard method is obtained.

A new method to determine the sulfur content of mineral oils is described by R. Heinze (Braunkohle, 39, 519).

The sulphur determination is carried out by a combustion of the mineral oils, tars and their fractions in a horizontal tube which contains four glass frits in the combustion zone. The combustion products are absorbed and titrated after sulfurdioxide has been oxydized with hydrogenperoxide in 1/20-n potassium-hydroxide. Samples of solid or heavy fuels are weighed into and combusted in a boat. Easily vaporizing materials like gasoline are weighed into fine capillaries which are placed into a wider tube which in turn is prolonged into a capillary on the one end. This tube is so placed into the combustion tube that its capillary end shows to the introduced secondary air which will pass through it. The primary air flows around the tube. The combustion lasts from 20 to 40 minutes.

Telemetering and Supervisory Control Report Published

A report "Telemetering, Supervisory Control, and Associated Circuits," has just been published by the American Institute of Electrical Engineers.

Corrected to December, 1940, this report summarizes a wealth of information concerning the electric telemetering and supervisory-control systems currently in use or commercially available in the United States, and includes a detailed discussion of the interconnecting circuits suitable for such purposes.

Telemetering and supervisory-control equipment, although electrical developments and widely used in the electric power industry, are finding their greatest potential field of application in non-electrical industries. In water, oil, gas, and other industries this equipment is playing a vital and economically important role in such operations as the remote metering, indication, or control of the levels, pressures, temperatures, flows, etc., of liquids, gases, etc. Supervisory equipment is particularly adaptable to the remote control and monitoring of any device that may be electrically operated. In addition to control features, remote indications of the positions or conditions of practically any device — such as switch positions, governor settings, gate or valve openings, bearing or winding temperatures, synchronization, etc., etc. — may be obtained. Arrangements for the telemetering of various quantities may be incorporated in control systems.

In recognition of this ever-widening field of application for telemetering equipment, the report has been prepared in such form and terminology as to make it readily useful to engineers in any branch of industry likely to be concerned with problems of remote measurement and control. Extensive tabulations giving comparative data are designed to enable a prospective or existing user of telemetering or supervisory-control equipment quickly to determine the type of apparatus best suited to his requirements.

All known commercial sources of telemetering and supervisory-control apparatus in the United States have been canvassed, and every effort made to present a complete picture of the instruments and systems available for the purpose. Material for this special publication was prepared by a joint subcommittee of the AIEE committee on automatic stations and the AIEE committee on instruments and measurements. The work is based upon a report compiled by an AIEE subcommittee in 1932, although the coverage has been extended and of course the information has been brought down to date.

The special publication "Telemetering, Supervisory Control, and Associated Circuits" is a 28-page 8½ x 11-inch pamphlet attractively printed on durable paper. Copies may be secured from AIEE headquarters, 33 West 39th Street, New York, N. Y.; price is 40 cents per copy to members (80 cents to nonmembers) subject to a 20 percent discount for quantities of 10 or more mailed at one time to one address.

Filtering Material

Moraine Products Division, General Motors Corporation, Dayton, Ohio, has issued a bulletin on its new product, "Porex," a porous metal which can be used for filtering and diffusing liquids and gases.

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▼ PLANT ACTIVITIES ▼

A call for an abnormal expansion of refining facilities in the United States came from Harold L. Ickes, petroleum coordinator, whose plans are for tripling the output of 100-octane gasoline. His statement was to the effect that 50 new refining plants and an unspecified number of by-products plants would have to be built at a cost of $150,000,000.

Since full details have not been given, it may be that alkylation, polymerization, isomerization and iso-octane plants to be built at existing refining centers are the immediate need.

His estimate for tripling the output of 100-octane gasoline is being accepted as a need for 120,000 barrels daily. Requirements of the domestic defense program, as well as aviation gasoline for England and Russia evidently are included in the requirement.

Addition of fractionating equipment at natural gasoline plants for separating iso-butane from normal butane as part of the feed for alkylation units undoubtedly will be included in the tripling of top aviation grade gasoline.

Fluid Catalyst Plants: Construction has been started on two plants, which will use the fluid catalyst process, announced earlier in the year by Standard Oil Development Company. One of the units is being built by Standard Oil Company of Louisiana at Baton Rouge. The other is being built by Humble Oil & Refining Company.

At the time the process was announced officials of Standard Oil Company of New Jersey said three units would be built, the third being for its Bayonne, New Jersey, plant.

Due to the necessity of secrecy concerning new processes, details of the catalyst and the methods of operation have not been made public.

Aviation Gasoline Plant: An alkylation unit as well as other equipment for the making of 100-octane aviation gasoline has been announced by Premier Oil Refining Company, Longview, Texas. Total cost of the expansion was given as $1,700,000 when announcement was made that priorities had been granted for the construction work.

Absorption Addition: Corpus Christi Corporation, Corpus Christi, Texas is adding absorption equipment and fractionation towers for its recycling plant in the Stratton field. Previously this plant had operated by separation of distillate from field gas by separation resulting from drop in reservoir pressure to that held within the plant. The new equipment will increase plant output as well as provide for finishing several grades of plant output.

Plant Completed: The plant of Baytown Ordnance Works, where toluol will be manufactured for military explosives, was completed last month and turned over to the Ordnance Department, under the contract by which it will be operated by Humble Oil & Refining Company. Completion was five weeks ahead of schedule.

The plant was built under a contract with the federal government at a cost of $11,857,000. Raw material will come from the Baytown refinery of Humble Oil & Refining Company nearby. Output is expected to be in excess of 24,000,000 gallons of toluol annually.

M. L. Synder, who has been assistant superintendent of the Humble refining plant, is superintendent of operations. Most of the operating personnel came from the Humble plant.

Colonel John G. Booton of the Ordnance Department, United States Army, Fort Sam Houston, will be government supervisor in operation of the plant.

Alkylation Unit: Construction of an alkylation unit at the Augusta plant of White Eagle Division, Socony-Vacuum Oil Company is under consideration. The unit will serve as part of the expansion of facilities for the manufacture of 100-octane gasoline. Size of the plant and its cost will be announced later.

Cracking and Poly Units: Indiana Farm Bureau Cooperative Association, Inc., Mt. Vernon, Indiana, has begun construction of a Dubbs cracking unit and a UOP catalytic polymerization unit as additions to its skimming plant at Mt. Vernon, Indiana. The units were designed by engineers of Universal Oil Products Company and construction is by Frick-Reid Supply Corporation.

The plant has skimming capacity of 3000 barrels daily and operates on crude from the Griffin, Indiana, pool.

The Dubbs unit will be of the two-coil selective type, with capacity of 1800 barrels daily. The polymerization unit will be the non-selective type with ca-

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pacity of 1,000,000 cubic feet of cracking still gases daily.

Liquidating: All equipment in the 10,000-barrel plant of the Rodessa Oil & Refining Company, Shreveport, is being sold by Brown-Strauss Corporation, Kansas City, which bought the idle equipment several weeks ago.

Capacity Increase: Throughput of the Great Bend, Kansas, plant, bought recently by Sonken - Galamba Supply Company of Kansas City, is to be increased from 2000 to 3500 barrels daily. It was operated previously by Falcon Refining Company.

Unit Completed: Frontier Refining Company has completed a cracking unit of 750-barrels-daily capacity at its plant at Cheyenne, Wyoming. Crude capacity is 1500 barrels. General offices of the concern are being moved from Denver to Cheyenne.

Enlarging Capacities: Throughput of both the refining plants of Arrow Petroleum Company are being expanded. The plant at Forest Park, Illinois, will have capacity of 7000 barrels daily, while the capacity of the plant at Centralia will be increased from 2000 to 3000 barrels daily. The Centralia plant was bought recently from Egyptian Producing & Refining Company.

Second Gasoline Plant: Sunflower Gasoline Corporation has put its second gasoline plant in the Salem field, Illinois, in operation. It will process 20,000,000 cubic feet of gas and liquid recovery will be fractionated for propane and butane recovery.

The other plant has been in operation since last year. Residue gas from the two plants will be used as fuel for refining and industrial plants in Centralia.

"Done in Oil," by Leven, Presents Oil Encyclopedia

An extensive encyclopedia of the oil industry is provided by "Done in Oil," by David D. Leven.

Chapter headings include petroleum economics, capital investments and expenditures, supply and demand, major oil-field operations by states, maintaining oil reserves, oil conservation and proration, international oil situation, Mexico's oil expropriations, importance of oil in war, petroleum industrial organization, petroleum sciences, petroleum prospecting, drilling operations, casing the well, bringing in the well, protecting the well, producing the oil, secondary methods of production, costs and valuations, petroleum storage, transportation, refining, natural gas, natural gasoline, crude oil marketing, marketing refined products, capital investments, investments and appraisals, oil company reports, valuation of wasting assets and problems of depletion, corporation finances involved in the petroleum industry, principles of investments and the working of the security markets, diversified royalty investments, oil royalty business, purchase and sale of royalties, principles of royalty ownership, royalty information and procedures, oil leases, appraising and valuing royalties, investment and royalty trusts, the oil situation vs. royalty investments, conservation vs. royalties, investments regulated, regulation of oil royalties, taxing the petroleum industry.

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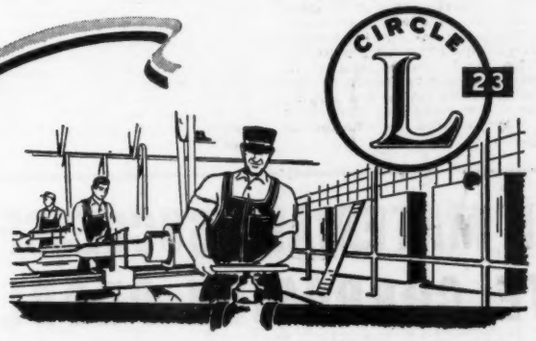

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SCIENCE AND TECHNOLOGY

Abstracts prepared in co-operation with the

REFINER AND NATURAL GASOLINE MANUFACTURER

by

THE LESLIE LABORATORIES

Traver Road, Ann Arbor, Mich.

under the supervision of

DR. E. H. LESLIE and DR. H. B. COATS

The abstracts here presented are selected from the current literature of science and technology to afford reference to fundamental information not easily available to all readers. Abstracts of articles appearing in readily obtainable trade journals are not included.

Photostat copies of original articles will be supplied at cost by the Leslie Laboratories. Complete or limited bibliographies covering special topics by title, by abstracts, or in complete manuscript, will also be prepared and furnished at reasonable cost by the Laboratories.

Fundamental Physical and Chemical Data

The Refractive Index of Paraffins in Terms of the Number and Frequency of the Dispersion Electrons, S. S. KURTZ, JR., AND M. R. LIPKIN, *Jour. Amer. Chem. Soc.* **63** (1941) pp. 2158-63.

The modified Sellmeier-Drude equation is used to correlate refractive index-density data for both normal and average paraffins. It is shown that there is approximately one dispersion electron per formula bond, and that the frequency is linear with the density in any homologous series. The refractive index of the normal paraffins can be calculated within $\pm$ 0.0002 and the refractive index of average paraffins within $\pm$ 0.0005. Refractive index of the paraffins can be calculated for any wave length of light, and for any temperature or pressure, provided the corresponding density is known. The significance of the ϕ coefficient in the Sellmeier-Drude equation is briefly discussed. The relationships between frequency V_0, energy in ergs, and wave length in ängstrom units corresponding to bonds in the normal paraffin homologous series are shown graphically. For any one paraffin, the shift in frequency and wave caused by change in density is appreciable.

Viscosities of Homologous Series at Equal Temperatures, A. H. NISSAN AND A. E. DUNSTAN, *Jour. Inst. Petr.* **27** (1941) pp. 222-5.

The authors find that the logarithm of the viscosity is connected more directly with molecular volume than with molecular weight. The formula $\log \mu = A$ (molecular volume) + B applies more accurately than the original form, $\log \mu = A$ (molecular weight) + B when a wide range of numbers of a homologous series is considered. Data are given in tabular form, and also plotted in the form of curves that show the accuracy with which the equation applies to the paraffin and to the alkyl benzenes.

Conductivity of Insulating Oils under Alternating Stress, J. B. WHITEHEAD AND B. P. KANG, *J. Appl. Physics* **11** (1940) p. 596.

Measurements of the conductivity of insulating oil as manufactured and after oxidation were made. The measurements were made under a voltage gradient of 20-80 volts per mil, and special care was taken to record the initial or short-time conductivity. The ratios of the initial to final conductivities read were in the range 3-5.5. The dielectric loss under 60 alternating current agreed with the loss calculated as leakage caused by initial conductivity.

Boiling Points of Benzene, 2:2:3-Trimethylbutane, 3-Ethylpentane, and 2:2:4:4-Tetramethyl Pentane within the Range 100-1500 mm. of Mercury. E. R. SMITH, *Bur. Stand. J. Res.* (Wash.) **26** (1941) pp. 129-134.

Vapor pressure measurements were made by the method of Swietoslawski using water as the reference standard. The benzene used in the work was prepared in a previous fractionation. The other hydrocarbons were obtained from the automotive Power Plant Section of the Bureau of Standards. Temperatures were measured to 0.001° C., and it is believed that, considering the purity of the hydrocarbons, the results are accurate to better than 0.01° C. From the data obtained the following equations were developed expressing the relationship between temperature and vapor pressure in the range of pressures 100-1500 mm. of mercury:

Benzene:

$$\log_{10} p = 6.905216 - \frac{1211.215}{220.870 + t}$$

2:2:3-Trimethylbutane:

$$\log_{10} p = 6.799682 - \frac{1204.997}{226.615 + t}$$

3-Ethylpentane:

$$\log_{10} p = 6.873058 - \frac{1249.825}{219.595 + t}$$

2:2:4:4-Tetramethylpentane:

(a) From 100-450 mm.:

$$\log_{10} p = 6.643408 - \frac{1231.620}{204.975 + t}$$

(b) From 430-1500 mm.:

$$\log_{10} p = 6.860684 - \frac{1368.925}{221.679 + t}$$

In these equations p is the vapor pressure in standard mm. of mercury exerted by the substance at temperature t° C.

Velocity of Compressional Waves in Petroleum Fractions at Atmospheric and Elevated Pressures, R. MATTESON AND C. J. VOGT, *J. Appl. Phys.* **11** (1940) pp. 658-65.

The velocities of compressional waves in 37 petroleum fractions ranging from light gas oils to viscous lubricating oils were measured at 100° F. and atmospheric pressure. The wave velocities were calculated from wave-length determinations as made by means of a Hubbard ultrasonic interferometer used with a quartz crystal ultrasonic wave-generator. The compressional waves in the oil were reflected from a piston mounted on a micrometer screw. The position of the nodes was determined by the deflections of a galvanometer in the generator-plate circuit. The measurements were found to be essentially those corresponding to an infinite medium, for viscous drag and tube-wall expansion are negligible. Curves are presented from which the velocity of compressional waves at 100° F. and atmospheric pressure can be read if the specific gravity and kinematic viscosity of the oil are known. To show the effect of chemical composition measurements were made using several pure hydrocarbons, and velocity-temperature curves for these are given. Measurements were made at elevated pressures up to 6000 lb./sq. in. and at temperatures from 57° F. to 210° F. The results of these measurements in-

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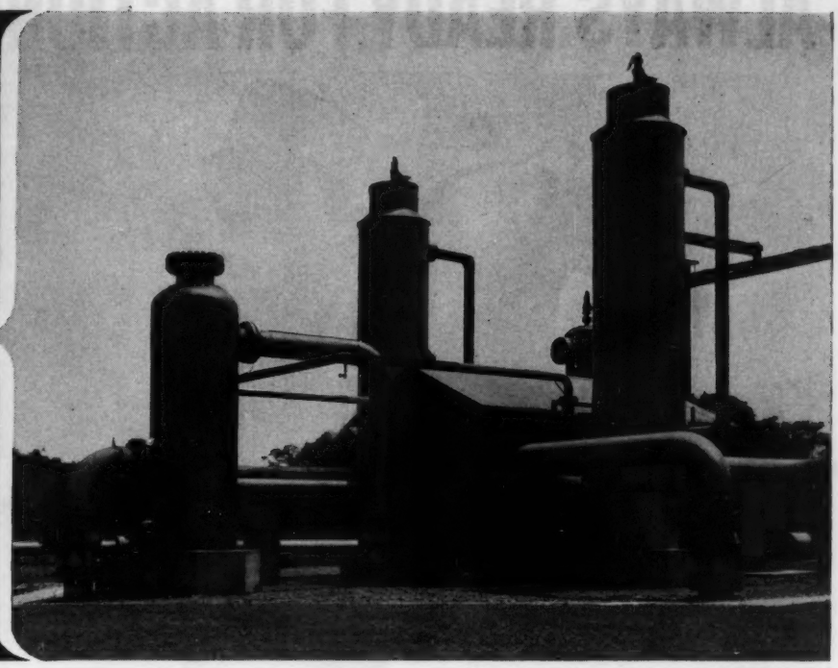

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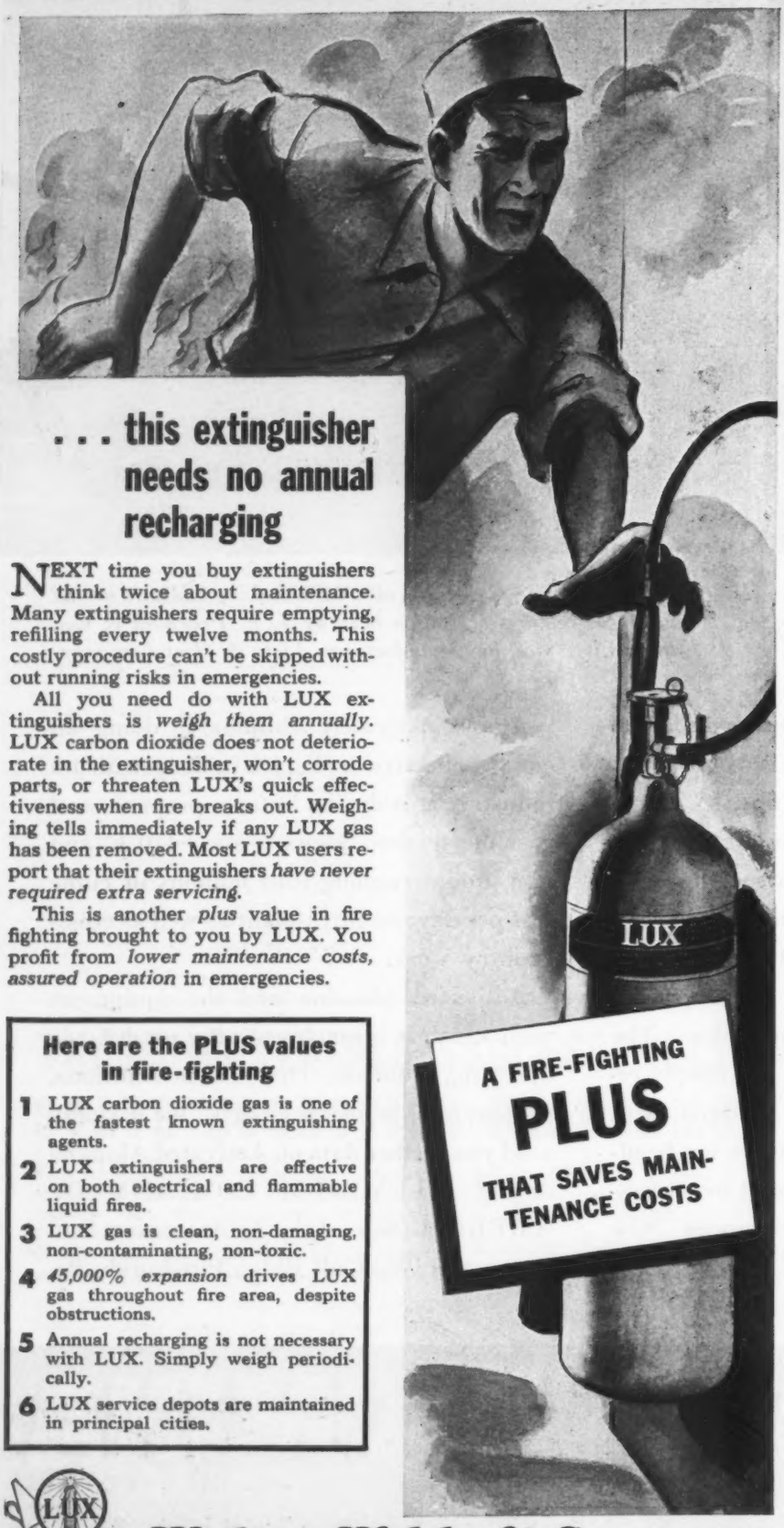

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dicate that the more readily made tests at atmospheric pressure can be reduced to the conditions found in diesel-engine fuel lines through use of the Helmholz relationship. The wave velocities characteristic of the average injection system may vary as much as 25% through the range of operating conditions and oils in use today. This variation may easily be the cause of a change from satisfactory to unsatisfactory engine operation.

Chemical Compositions And Reactions

Formation of Propylene by Dehydrogenation of Propane, M. KUROKAWA AND Y. TAKENAKA, *J. Soc. Chem. Ind. Japan* **44** (1941) pp. 45B-47B.

The authors present results of experiments on the catalytic and non-catalytic decomposition of propane. The object was to prepare propylene from propane by dehydrogenation. The optimum temperature for dehydrogenation of propane was found to be between 600° and 650° C. The ratio C_3H_6/C_2H_4 increases with gas velocity. Of the catalysts used, UO_3, CuO, AgO, Al_2O_3 and Mn_2O_3, UO_3 was found to be the best. It has the least activity in the reverse reaction.

Reaction Product of Olefins with Sulfuric Acid, R. F. ROBEY, *Ind. & Eng. Chem.* **33** (1941) pp. 1076-8.

The primary reaction of sulfuric acid with the lower monoolefins results in the formation of the corresponding acid sulfate ester or alkylsulfuric acid. In the industrial production of the lower alcohols and their derivatives, olefins polymers, and alkylates from hydrocarbon fractions resulting from petroleum refinery cracking operations, the reaction of the olefins with sulfuric acid plays an important part. The investigation reported is largely concerned with the composition of the acid liquors or extracts produced under mild reaction conditions. The composition of the acid reaction product of n-butenes with sulfuric acid was studied. Only 30 to 40 percent of the butene content of the reaction product with 80 percent acid can be accounted for as alkylsulfuric acid. The remainder is believed to be present in the form of alcoxonium ion, proposed by modern theories of acid-catalyzed ester hydrolysis. In the light of the experimental findings it is believed that heat of the reaction of olefins and sulfuric acid as reported in the literature may be several hundred percent too high.

The Production of Benzene, G. E. FOXWELL, *Coke Smokeless-Fuel Age* **3** (1941) pp. 15-18, 28-32.

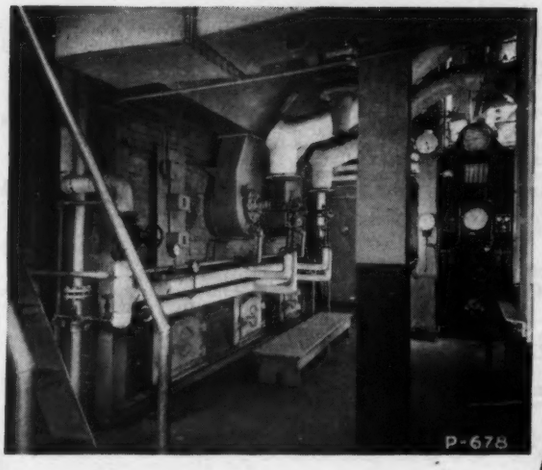
The subject of the conversion of paraffins into olefins and conversion of olefins into naphthenes and aromatic compounds is reviewed. The methods considered are alkylation, polymerization and thermal or catalytic cracking. In coke-oven practice, the yields of toluene and xylene are increased if the center gas offtake is used. Maximum yield of these aromatic hydrocarbons is had if the temperature is 800° to 900° C. Hydrocarbon gases can be cracked to yield toluene in amounts of 0.23 gallons of toluene per 1000 cubic feet of gas. When petroleum oil is cracked by the Sarmiza process in 3 stages a yield of 64 percent of motor spirit is obtained.

On the Polymerization of Ethylene and Propylene by Free Alkyl Radicals, O. BEECK AND F. F. RUST, *J. Chem. Phys.* **9** (1941) pp. 480-3.

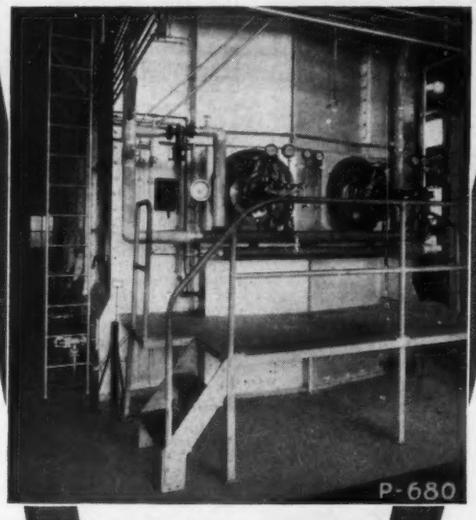
Methyl- and ethyl-induced polymerizations of ethylene and propylene were effected under static and under flow conditions. Sufficient material for fractionation at low temperature was obtained in the flow experiments. Propylene is not polymerized as effectively as ethylene because of the ready formation of alkyl radicals. The polymers are formed by the successive addition of olefin molecules to radicals. Chain transfer through the decomposition of radicals occurs, and the chains are terminated by disproportionation or through the association of 2 radicals.

Polymerization of Olefins. V. The Isomers in Triisobutylene, F. C. WHITMORE, C. D. WILSON, J. V. CAPINJOLA, C. O. TONGBERG, G. H. FLEMING, R. V. MCGREW AND J. N. COSBY, *Jour. Amer. Chem. Soc.* **63** (1941) pp. 2035-41.

The fractionation of the triisobutylenes was undertaken in an attempt to separate the various isomers because the structure and ratio of these olefins are important in the work on polymerization that has been in progress in the authors' laboratory since 1932. Repeated fractionations of triisobutylene through col-



Versatility



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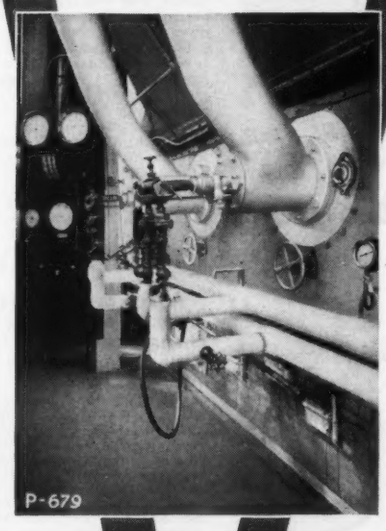

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umns of upward of 100 theoretical plates gave a partial separation into lower and higher boiling materials in the ratio of about 9:1. The lower boiling isomers of triisobutylene were shown to be 2, 2, 4, 6, 6-pentamethyl-3-heptene and 2-neopentyl-4, 4-dimethyl-1-pentene, or unsym-dineopentylethylene. Dineopentylethylene is more resistant to ozonolysis than its isomer. The higher boiling isomers of triisobutylene consist of 2, 4, 4, 6, 6-pentamethyl-1-heptene and 2, 4, 4, 6, 6-pentamethyl-2-heptene in about equal quantities. No evidence was found for the presence of 2, 4, 4-trimethyl-3-t-butyl-2-pentene as has been reported by other workers.

The Polymerization of Olefins. VI. The Dimers Obtained from Tetramethylethylene. Preliminary Paper, F. C. WHITMORE AND P. L. MEUNIER, *Jour. Amer. Chem. Soc.* **63** (1941) pp. 2197-99.

The work reported was undertaken to throw further light on the mechanism of the polymerization of olefins by acid catalysts. Tetramethylethylene was polymerized at 0° C. with 80% sulfuric acid. The results of Brunner and Farmer using boron trifluoride were confirmed and extended. The chief products in the dimer are: 2, 2, 3, 5, 6-Me_5-5-heptene (about 50%), 2, 2, 4, 6, 6-Me_5-3-heptene (about 25%), 2, 3, 4, 6, 6-Me_5-2-heptene (about 10%), 1, 1-dineopentylethylene (about 0.2%). All of the observed products correspond to rearrangements both before and after the union of the parts of the dimers. Although the formation of the dimers cannot be explained by any existing theory of polymerization it fits a combination of the rearrangement and polymerization theories current in the Penn State Laboratory.

Polymerization of Olefins. VII. The Isolation and Oxidation of 1,1-Dineopentylethylene, F. C. WHITMORE AND J. D. SURMATIS, *Jour. Amer. Chem. Soc.* **63** (1941) pp. 2200-1.

The resistance of 1, 1-dineopentylethylene to oxidation has been confirmed. 1, 1-Dineopentylethylene can be readily obtained in about 15% yields from the oxidation of crude triisobutylene. The oxidation of 1, 1-dineopentylethylene by chromic acid mixture gives about 25% of dineopentylacetic acid and 50% of unchanged olefin.

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Manufacture: Processes And Plant

Petroleum as a Raw Material, A. W. NASH, *Jour. Inst. Petr.* **27** (1941) pp. 195-213.

The author reviews the subject of petroleum as a raw material, and indicates the importance of scientific work in its design to extend utilization of petroleum as a raw material. He points out that Great Britain, as a nation, has not risen to her responsibilities in the promotion and encouragement of the development of scientific knowledge, as she has not led in the fields of study directed to the utilization of petroleum, and that it is essential that something be done about it. The subject is considered under six separate headings: the saturated hydrocarbons, the unsaturated hydrocarbons, the oxygenated compounds, cyclic compounds, sulfur compounds, and nitrogen compounds. Under the paraffins the subjects of thermal decomposition, reaction with steam, reaction with halogens, and oxidation, are considered. Under the subject of the unsaturated hydrocarbons, pyrolysis and polymerization, hydration and esterification, reactions with the halogens, and olefin oxides, are considered. Under the oxygen-containing compounds, the alcohols, glycols and glycerine, the aldehydes, the ketones, and acids and esters, are discussed. In considering the cyclic compounds, methods of production are first reviewed, followed by consideration of treatment with aluminum chloride, chlorination, oxidation, halogenation, and production of naphthenic acids and their salts. Among the sulfur compounds discussed are hydrogen sulfide, mercaptans, and sulphonic acids. Among the nitrogen compounds considered are the nitrogen bases and the nitrates and the nitrites, as well as the nitroparaffins. The article concludes with a plea for the allocation of funds for research work in this tremendously important field.

Heat Transmission to Boiling Binary Liquid Mixtures, C. F. BONILLA AND C. W. PERRY, *Trans. Amer. Inst. Chem. Engrs.* **37** (1941) pp. 685-705.

The investigation was undertaken to develop a method of design for apparatus used to add head to multicomponent liquids. A horizontal surface was used, and the results indicate that the coefficients obtained are roughly the same as those for boiling outside of single horizontal tubes. The heaters allowed attainment of film boiling, and permitted visual observation. The pure liquids studied were water, ethanol, n-butanol, and acetone. Their six binary mixtures cover a fairly wide range of physical properties. It was found that curves of heat transfer rate against temperature difference for boiling binary mixtures lie between those for the pure components. The high range Jakob and Linke correlation for boiling is improved by including the Prandtl Number, and both it and the Insinger and Bliss correlation apply to boiling from horizontal surfaces. An approximate general correlation of maximum boiling rate and of temperature difference at constant rate against composition is obtained for binary mixtures, and against pressure for pure liquids.

Alignment Chart for Optimum Amount of Cooling Water in Heat Exchangers, R. D. DOUGLASS AND D. P. ADAMS, *Ind. & Eng. Chem.* **33** (1941) pp. 1082-3.

The cost of the cooling water used in a condenser or in a cooler depends on the cost of the water itself, on the development of a service pressure, and on the fixed charges for the cooling surfaces. An equation is developed for the optimum cost, but unfortunately it can be found only by a laborious method of approximation. An alignment chart is presented that permits quick and easy reading over the entire range of the variables arising in practice. A typical problem is stated, and its solution by the use of the chart is given.

Graphical Design of Continuous Distillation Columns for Ternary Mixtures, C. F. BONILLA, *Trans. Amer. Inst. Chem. Engrs.* **37** (1941) pp. 669-84.

A graphical method is presented for designing three component distillation equipment. The method is somewhat simpler than that of Thormann, in that no auxiliary diagram is required. The method is developed for constant molal overflow, and in an approximate form for non-constant overflow. Graphical design for side streams and for mixed feed are covered. In contrast with most other methods of design in connection with multicomponent systems which first estimate the feed plate composition, the method pre-

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Can you afford to burn it as is?

If you run that gas through a U. O. P. catalytic polymerization unit it will give you about 5 to 7 gallons of polymer gasoline per 1000 cubic feet — 81-83 octane number — and you will have about 70 per cent of the gas left for fuel, still of high B.t.u. content

You know how much fuel gas is worth in your plant and you know what you can get for 81-83 gasoline

Take your pencil and figure how much you may be losing

Your cracked gas may be above or below average — we'll be glad to find out and tell you

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Your cracked gas may be above or below average — we'll be glad to find out and tell you

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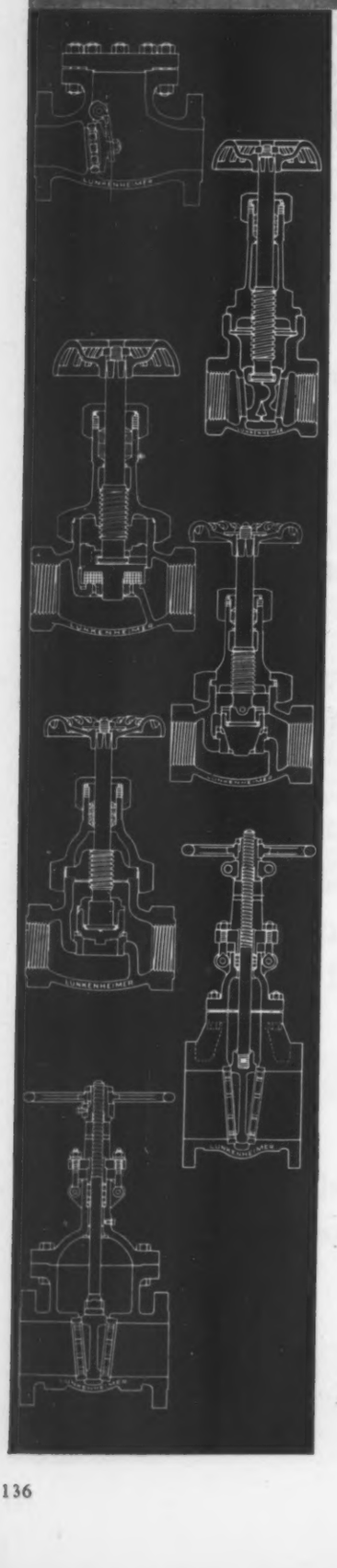

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sented starts with the desired composition at one end of the column, preferably the end where only one of the compounds is in small concentration.

Binary Liquid Mixtures, D. B. KEYES, *Ind. & Eng. Chem.* **33** (1941) pp. 1019-21.

The use of a third component to improve separation of azeotropic solutions or binary liquid mixtures, such as that of two hydrocarbons, by the process of fractional distillation, has recently attracted considerable interest, and is now a process of some commercial importance. Ethyl alcohol and water have been separated in this country on a large commercial scale for some years by use of a third component such as benzene, which forms a ternary azeotropic mixture that separates in two liquid phases. Acetic acid and water are separated in a similar manner. More recently hydrocarbons boiling close together have been separated by use of a third component. The basic requirements for the effective use of a third componnt are: 1. The third component should be so chosen that it will reduce the partial pressure of one component in the original solution much more than that of the other component. 2. The condensate from the top of the column should separate into two liquid phases in order that the third component may concentrate in one liquid phase and be readily recovered and used again. 3. The existence of binary and especially ternary azeotropic mixtures should be avoided when possible. 4. The above conditions can sometimes be had by the use of a fourth component or by adjusting temperature and pressure conditions rather than by the selection of an entirely new third component.

Characteristics and Performance of a Nine-Inch Liquid-Liquid Extraction Column, S. B. ROW, J. H. KOFFOLT AND J. R. WITHROW, *Trans. Amer. Inst. Chem. Engrs.* **37** (1941) pp. 559-595.

The authors note that liquid-liquid extraction has become an important commercial operation, as, for example, in the extraction of lubricating oils. These developments have emphasized the need for a study of equipment performance and of the theoretical aspects of the extraction problem. The literature of the subject is briefly reviewed. Packed columns, "Spray" columns, and bubble cap and perforated plate columns were reviewed in the course of the investigation. The extraction column used was 8¾ inches inside diameter, i.e., larger than columns that have been used in previous work. This was done to avoid the wall effect and other peculiarities of small columns, and to afford information that would be useful in the design of large towers. The data from several hundred runs were taken, and are presented in the article in tabular and graphical form. As a result of the investigation it was concluded that Colburn's H.T.U. method of correlating liquid-liquid extraction is simple, clear, and accurate, and permits a rapid evaluation of results, if it is confined to rates of flow where apparent break-up of liquid bubbles does not occur. On the other hand, high rates of flow of the continuous phase have a profound influence on the overall H.T.U. This effect can be minimized by increasing the rates of the discontinuous phase and by the use of packing. The size of the distributor holes for the discontinuous phase has a marked influence on the capacity and H.T.U. values; the smaller the size the better the performance of the tower. A tower packed with Raschig rings had a slightly greater capacity than one packed with Berl saddles. Other considerations, such a flood point, pressure drop, and hold up, favor Berl saddles. A function is given, which, when plotted versus H.T.U. serves as a useful criterion in evaluating the performance of packing of liquid-liquid extraction columns. A copper knitted cloth packing was found to have little, if any, advantage, over a "spray" column. However, it demonstrated the importance of considering the nature of the surface of the packing in liquid-liquid extraction. The performance of perforated plates and bubble cap columns were found to be practically the same. These columns were more efficient than the "spray" column, but less efficient than the Berl saddle or Raschig ring packed columns.

Progress Report on Liquefying City Natural Gas Supply, J. A. CLARK, *Chem. & Met. Engr.* **48** (1941) pp. 90, 92.

The paper is a progress report describing the results obtained in the first winter's operation of the plant of the East Ohio Gas Company at Cleveland for the storage of natural gas in liquefied form. Although not exactly determined, it is believed that the cost of the plant will be approximately $1,250,000.00. Operation started on February 7 on the production of liquid gas. The first cold wave came on February 19, and at that time 15,000,000 cubic feet of liquid gas was in storage. On this date 7,000,000 cubic feet was regasified and put back into the lines. A severe cold wave hit Cleveland on March 17, when 50,000,000 cubic feet was in storage. During the two days of this cold spell the

WHY THE *Cork Situation* DEMANDS A RESERVE SUPPLY

GLANCE at this map and you will quickly understand why there is a "cork situation" in the United States. All of the world's cork supply comes from the forests indicated by the white dots on this map. It is obvious that present world conditions make the transportation of anything from this area a hazardous undertaking. In spite of the difficulty cork is still coming in. But, the future is another matter, because these ports and waters may later be closed to ordinary commerce.

As a safeguard against such an eventuality, our Government started in June to build a reserve stock pile of cork. Aided by neutral ships and by restrictions governing the usage of available cork in this country, this stock pile is growing steadily but is still less than the tonnage desired. Until this reserve supply is built up to the point considered necessary to insure the safe completion of the nation's defense program, cork will have to be used sparingly. Your Armstrong salesmen may have to ask for your continued patience with delivery delays and usage restrictions.

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536

plant fully justified its construction, as 16,000,000 cubic feet was regasified and put into the city plant on March 17, and 5,000,000 cubic feet on March 18. The result to the gas company was the ability to handle without curtailment an industrial load of over 40,000,000 cubic feet per day. The plant was designed for, and will make 4,000,000 cubic feet of gas per day into liquid. It is believed that the operating cost will amount to approximately 15.8c per 1,000 cubic feet handled. The cost of regasification, it is believed, will be approximately 21.3c, making the total cost of the liquefaction and regasification 37.1c per 1,000 cubic feet. This does not include fixed charges on the first cost of the plant. Data are given on the reevaporation rate of the liquid gas from the tanks in which it is stored at 260°F. below zero. The management of the company feels that the plant has fully justified the money invested in it.

Products: Properties And Utilization

Bituminous Coatings, A. O. BECKMAN, R. M. BADGER, E. E. GULLEKSON AND D. P. STEVENSON, *Ind. & Eng. Chem.* **33** (1941) pp. 984-90.

Bituminous materials, such as asphalt and coal tar, are used extensively for the protection of metal structures against corrosion. The investigation reported was concerned with studies of mechanisms through which metals protected by bituminous membranes corrode. These mechanisms include electroosmosis, diffusion of water, diffusion of electrolytes, and intrusion of water through small holes or fissures. It was found that electroosmosis and ionic diffusion are very small, and that diffusion of water is not sufficiently large to account for the amount of rusting frequently encountered in commercial experience. From surface tension and wetting angle measurements of the bituminous membrane-aqueous solution interface, it is shown that a pinhole imperfection of 0.1 mm. radius will permit penetration of water to a depth of several centimeters in some bituminous membranes. The apparatus used in the work is described in some detail, and the data taken are presented in 9 tables and 6 charts.

Permeability and Absorption Properties of Bituminous Coatings, A. P. ANDERSON AND K. A. WRIGHT, *Ind. & Eng. Chem.* **33** (1941) pp. 991-5.

The investigation was a study of the permeability of bituminous coatings by the usual agents of corrosion, water and oxygen. Water and oxygen slowly penetrate the coatings by molecular diffusion, but their concentrations remain so low that they cannot cause corrosion by the usual electrochemical process. Electrolytes are effectively excluded by coatings that are intact as shown by microscopic inspection. Practical tests show that pipe lines can be adequately protected from the action of corrosive soils by bituminous coatings that have been formulated correctly for the desired physical properties and that have been properly applied. The apparatus used in the work is described in some detail.

A New Laboratory Fractionating Column Head, TZENG-JIUEQ SUEN, *Ind. & Eng. Chem.*, Anal. Ed. **13** (1941) p. 519.

The authors note that most laboratory fractionating column heads are either very elaborate to construct or very expensive to buy. A simple column head is described by the authors, which, it is stated, was found to be very satisfactory in actual use. The amount of reflux can be determined by counting the liquid drops going back to the column. The level of the cooling water in the partial condenser can be adjusted by raising or lowering the outlet tube. The thermometer is not affected by being surrounded by the cooling medium.

Mineral Oil Deterioration System, J. C. BALSBAUGH AND A. G. ASSAF, *Ind. & Eng. Chem.*, Anal. Ed. **13** (1941) pp. 515-19.

The apparatus is described for the study of mineral oil deterioration. The features sought in the design of this apparatus were: an all-glass apparatus, a closed system, an adequate dispersion of the gas phase in the oil and adequate circulation of the liquid phase, a system that permits oxygen absorption measurements, a method of withdrawing samples at intervals, a means for adding catalysts or other materials, provision for removing or retaining volatile products as desired, and the ability to make electrical measurements on the sample in the deteriorating system. Also, it was desired to have an apparatus that will permit making studies on small quantities of oil, so as to make practicable work with straight hydrocarbons or with special samples

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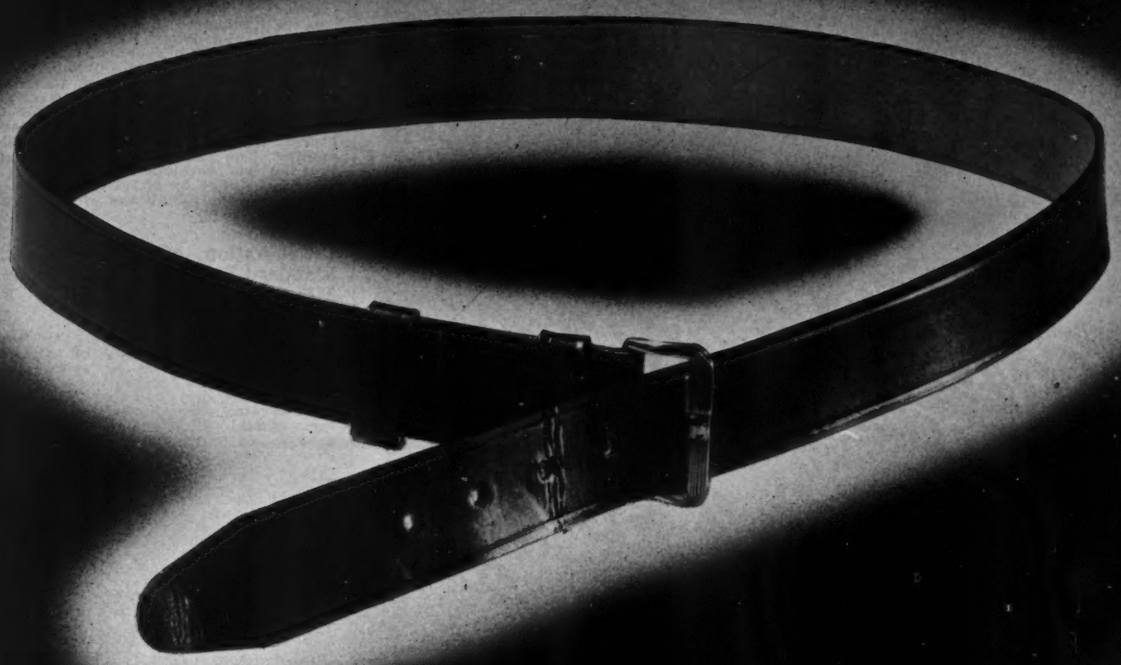

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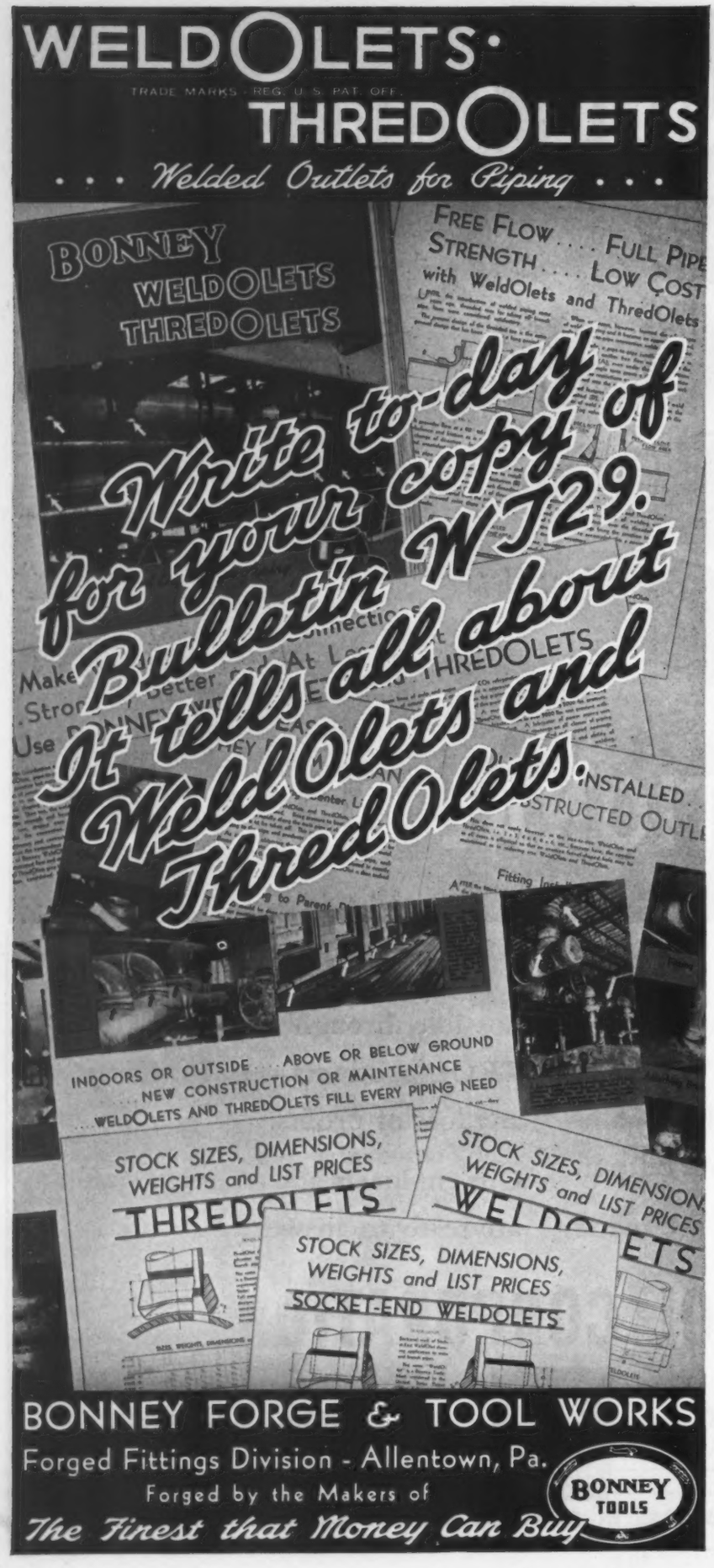
AGENTS AND WAREHOUSE STOCKS IN PRINCIPAL REFINING CENTERS OF THE WORLD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that might be taken from various stages of a refining process. The apparatus has been used for studying mineral oil deterioration under a variety of conditions, such as continuous oxidation at atmospheric pressure, limited oxidation with only a definite amount of oxygen admitted to the system.

Methods for Clarifying Oxidized or Used Mineral Oils and Determining Sludge, G. O. EBREY, *Ind. & Eng. Chem.*, Anal. Ed. **13** (1941) pp. 549-50.

It is frequently desired to obtain deteriorated oil in a clarified condition free of undissolved sludge. Such terms as "oil insolubles," "undissolved sludge," "dissolved sludge," and "resins" are in fact defined by the methods utilized for their separation, but no procedures now in use are able to effect 100 percent separation of these materials if a literal interpretation of this terminology is applied. The author describes the apparatus that he has developed and used for the removal of sludge by filtration. Typical data are given, and the advantage of the procedure is discussed.

Calibration of Tetraethyl Lead in Standard Reference Fuel C.12 by C.F.R. Motor Method, *Jour. Inst. Petr.* **27** (1941) pp. 230-2.

The paper is a report of the Institute of Petroleum Knock Rating of Aircraft Fuels Panel Sub-Committee. At a meeting of the committee it was decided to prepare a calibration of tetraethyl lead in C.12 reference fuel. It was also agreed that primary reference fuels should not be employed in this instance, as two accepted subreference fuel calibrations were available for providing cross checks—namely, tetraethyl lead in C.11 and F.3 in C.12. Four concentrations of tetraethyl lead in C.12 were rated in twelve C.F.R. engines owned by seven laboratories, thus providing twenty-four ratings for each point. Test data are presented in tabular and graphical form.

Revised Standard Method of Test for Distillation of Liquid Asphaltic Bitumen (Tentative), (I.P.T. SERIAL DESIGNATION C.B.3), *Jour. Inst. Petr.* **27** (1941) pp. 226-9.

A revised standard method of test for the distillation of liquid asphaltic bitumen, particularly cut-back asphaltic bitumen and road oils, is described. Flask, condenser, shield, graduated receiver, thermometer, and preparation of the sample, are described. The method is known as I.P.T. Serial Designation CB.3-1941 (T), or A.S.T.M. Serial Designation D.402-36 (modified).

The Uses and Testing of Gunned Asphalt, D. C. BROOME AND L. BILMES, *Jour. Soc. Chem. Ind.* **60** (1941) pp. 146-53.

Gunning, a new method of applying asphalt by spraying a powdered compound through a flame-gun, is described. The process is an adaptation of the well-known "metallising" procedure. The powder is fed into a cone fitted with a non-caking device, and thence is carried by a compressed air stream to the gun, passing out through a central nozzle around the periphery of which is situated a set of small holes. Oxygen and propane are fed to these latter in suitable proportions and ignited to form a ring of flame through which the powder passes. The nozzle is kept cool by means of compressed air. In its transit through the flame of the gun, the compound is heated and softened just sufficiently for the particles to fuse together on contact with the base on to which the material is being sprayed, thus providing a dense, jointless, and impermeable layer. Three sizes of gun are employed, and the speed of operation is normally adjusted so that thicknesses range from ⅛ to ¼ inch. Greater thicknesses can be built up by the application of more coats. The uses of the process are discussed, and the general characteristics of the asphaltic cement and aggregates employed are given. Two new tests for caking and flexibility as well as "impact" tests are described, and the results discussed analytically. The paper also includes a preliminary study of permeability and the fundamental rheological properties of the materials.

Harry G. Johnson has been named territorial salesman with headquarters at Indianapolis for Manning, Maxwell & Moore, Bridgeport, Connecticut. He will handle sales of all divisions, including Hancock valves, Ashcroft gauges, Consolidated safety valves and American industrial instruments. He succeeds Gerald Beebee, who has been granted leave of absence on account of illness.

FOR THE WANT OF A NAIL . . .

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ON THE slender thread of tremendous trifles may rest the difference between life and death, success or failure, happiness or sorrow. Legendary is the tale of a battle lost for the want of a nail. History tells how a tiny lad's sturdy arm thrust into a hole in a dike saved Holland.

In 1941 heroic but humble tasks are being accomplished every day by individuals and organizations whose self-effacement frequently prevents public recognition.

In the Texas sun a sprawling refinery is building. Day and night the hum of machinery and the shouts of sweating men fill the soft summer air. From this refinery runs a six-inch pipeline to Seaboard, 800 miles away. Beside it stands a trim and sturdy cooling tower, the redwood frame of which once grew in a California forest. All are monuments to Fluor's construction and engineering policy of "from plan to plant with undivided responsibility."

It seems a far cry from grimy erection crews toiling under the blazing sun of a Texas summer to sleek, deadly torpedo boats knifing their way through the Atlantic at fifty-five miles per hour on neutrality patrol. Yet, upon the work of one depends the work of the other. In compressor plants of oil producing companies and amid the rumble of heavy chemical processing machinery, wherever America is girding herself for defense, you will find Fluor cooling equipment operating, Fluor refining processes in use, Fluor engineers searching for improved ways to build better, to build faster.

As war clouds gather, Fluor, together with hundreds of American companies, is toiling to furnish materials and equipment that are symbolic of the legendary horseshoe nail. Upon them in a large degree depends the success of our armed forces on land, at sea and in the air.

For over 50 years The Fluor Corporation Ltd. has made good its every promise to industry; anticipates no deviation from this policy in the years to come. *Now as never before, be sure with Fluor.*

Since its inception, The Fluor Corporation Ltd. has consistently and conservatively applied methods and men to the task of designing, engineering and constructing plants and products that would contribute to the steady progress of the industries it serves. In addition to maintaining a complete designing, engineering and construction service, Fluor also designs, manufactures and erects a complete line of Atmospheric Aerator Type and Mechanical Draft Cooling Towers. Measurable operating and maintenance economies have been effected for the companies that have selected the engineering and construction services and the products of this organization. The Fluor Corporation is prepared to serve and assist you through its competent personnel in offices located from coast to coast.

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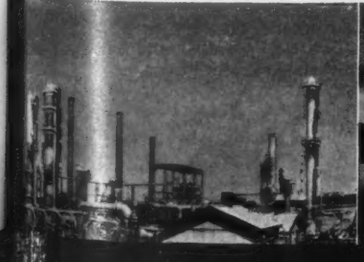
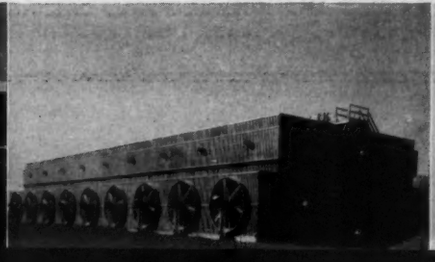
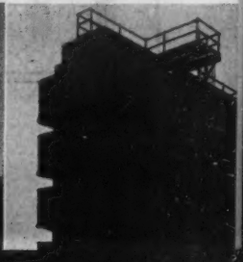






New Equipment for the Modern Plant

High-Temperature Packing
GREENE, TWEED & COMPANY

Greene, Tweed & Company, Bronx Boulevard and 238th Street, New York, has added a product, Cab Coat Packing for high-temperature services.

This packing is braided from long-fibre Canadian asbestos yarn. Each strand is individually coated with dry graphite to retard fusion of asbestos and to provide an anti-friction wearing surface. The packing contains no liquid lubricant which might be boiled away.

It is intended for pumps and valves handling high-temperature steam, oils, and gases, and also for expansion joints, furnace door grooves, locomotive cab cocks, and many applications in petroleum refineries.

Thread Grinder
LANDIS MACHINE COMPANY

Landis Machine Company, Waynesboro, Pennsylvania, has introduced a new model, Landis No. 6 Precision Thread Grinder. Flexibility of application to work diameters, lengths and thread pitches have been made convenient in its design.

Both work and wheel speeds are practically infinite throughout the full range of the machine. This permits greater accuracy of finish and maximum production possibility.

The machine is suitable for grinding both right and left hand external threads from 2 to 80 threads per inch, up to 6-inch diameter, 12-inch thread length on work having maximum center distance of 24 inches. Single or multiple National Standard, "V," Whitworth, Acme, Modified Buttress, and Worm threads having a maximum helix angle of 15 degrees may be ground on this machine. Studs, screws, and other parts

Landis Thread Grinder

which do not have centers may be ground with the use of a collet type chuck or special work adapter. The flanged nose of the work spindle of the machine is machined to conform to the American Standard for lathe spindles, thus, standard chucks of different types may be employed without using an intermediate flange or adapter.

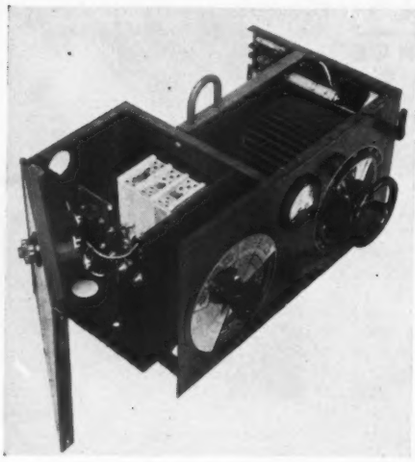
Simplified change gear box construction through the use of a minimum number of gears allows a greater number of both English and Metric pitches to be obtained. The spare gear compartment is located directly below the change gear box, while the gear chart for the various gear changes is attached to the inside of the gear box cover for convenience.

The work table and the wheel slide operate on accurately scraped surfaces on the bed of the machine and maintain a constant length of bearing at all times. The work table never overhangs the end of the machine base. The distance which the table will travel in either direction is controlled by adjustable trip dogs which are actuated through a limit switch.

Welder Control Box
THE LINCOLN ELECTRIC COMPANY

A welder control box for dual continuous control for arc welding machines has been announced by The Lincoln Electric Company, Cleveland.

Designated Type G, the box is designed to prevent accidental contact with live parts, increase accessibility, permit wiring with flexible or rigid conduit, or rubber-covered multiple-conductor cable, and to eliminate dangers from unintentional loosening of the lifting hook.



Lincoln Electric Control Box

It provides a separate compartment for all AC circuits, including push button, and another separate one for DC terminals. Both compartments have a snap catch which holds the door in closed position, with the AC compartment also provided with screws for locking to prevent an unauthorized person from opening the compartment and touching live parts. The snap catch on the door of the DC compartment makes terminals readily accessible without use of tools, and provides a complete cover for terminals when the door is closed.

Control box is permanently grounded to the motor and generator frames through mounting bolts to take care of special inspection rules that require that both control box and frame be grounded. A new lead clamp prevents bending or damage to output studs when welder leads are accidentally jerked or pulled.

Turbine Pumps
MICRO-WESTCO, INC.

Mirco-Westco, Inc., Bettendorf, Iowa, has a new series of single- and two-stage Westco turbine pumps incorporating an improved renewable liner. This feature minimizes shut-down losses and production delays; the liners, forming the liquid channel within the unit, can be easily renewed (along with the impeller), providing stand-by service at about one-fourth the usual cost of a duplicate unit.

The separate liner design also guards against premature obsolescence by permitting the pump capacity and range to be altered, within reasonable limits, in

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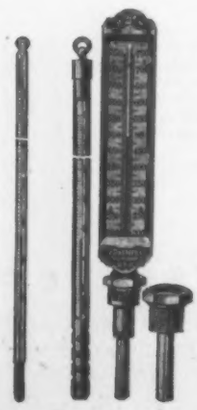

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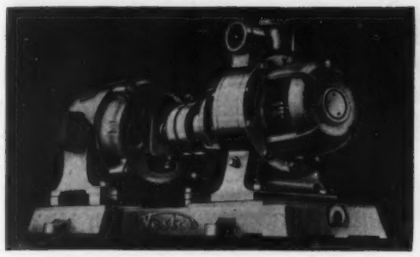


Westco Pump

the field. This alteration is accomplished without disturbing the suction or discharge lines, simply by replacing the liners with a different set and slipping a new, matching impeller into position.

Other constructional advantages include double ball-bearing construction, a top discharge, a stainless-steel shaft and free-floating impeller to eliminate seizing caused by extreme temperature variations, extra deep stuffing boxes that reduce the need for frequent repacking, and balanced bearing arms which minimize shaft misalignment.

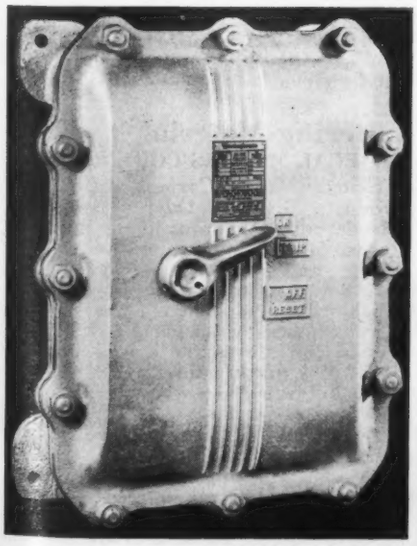
Designed especially for high-head low-capacity work, these Westco pumps are built not only for conventional service, but in addition, are engineered to meet the many industrial applications requiring high-pressure performance. For example, single- and two-stage pumps, with 5-inch impellers, will develop pressures up to 150 pounds and 300 pounds per square inch respectively at 1750 rpm.

Circuit Interrupter

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

A non-automatic circuit interrupter for disconnecting or interrupting AC and DC circuits in Class 1, Group D locations where atmospheres contain gasoline, natural gas and other explosive vapors, has been announced by Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania.

Manually operated, it is furnished with a NEMA Type 7 cast enclosure finished in aluminum with a closely ground fit between box and cover. Units are rated from 50 to 600 amperes, depending on frame size, and interrupting



Westinghouse Circuit Interrupter

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YOU CAN SAVE CHROMIUM for defense and save money in your own plant by using our Chrom Glucosate. You are wasting chromium, badly needed in our National Defense program, when you use it for corrosion control instead of chrom glucosate.

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	SODIUM BICHROMATE		
17 pounds	100 pounds	Calcium Brine	83 lbs.
17 pounds	200 pounds	Salt Brine	183 lbs.
34 pounds	500 pounds	Cooling Water	466 lbs.
	CHROMIC ACID		
3 pounds	66 pounds	Calcium Brine	63 lbs.
3 pounds	132 pounds	Salt Brine	129 lbs.
10 pounds	330 pounds	Cooling Water	320 lbs.

Furthermore, there are other glucosates that eliminate the need of chromium. Let us send you the whole story.

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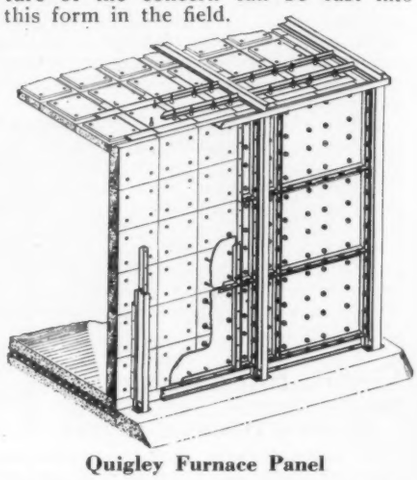
Furnace Wall Panels
QUIGLEY CONSTRUCTIONS, INC.

Quigley Constructions, Inc., subsidiary of Quigley Company, Inc., 56 West Forty-fifth Street, New York, has introduced a panel type construction for furnace walls. The plates consist of a panel backing plate with angle iron frame having bolt holes for attaching to adjacent panels or supports. To this backing plate is attached suitable reinforcement, around which a form is placed so materials of other manufacture of the concern can be cast into this form in the field.



Quigley Furnace Panel

Materials used in the panels are Insulcrete, a light weight refractory insulating concrete, and Insulag, a refractory insulating lagging. These products are cast singularly or in combination in various thicknesses to suit operating temperatures and conditions. Standard panels are 24 x 24 inches but special sizes and shapes can be supplied as required.

The panels are shipped ready for assembling into structure by inserting stud bolts and fastening in place with washers and nuts. The material shown in the illustration is Type C, with outside steel casing on the sides and suspended uncased roof, using modified panels with filler pieces over joints between panels.

Filtering Material
GENERAL MOTORS CORPORATION

General Motors Corporation, Moraine Products Division, Dayton, Ohio, has introduced a porous-metal product, Porex, for use in filtration and flow of liquids and gases. Its two principal functions are to remove foreign materials from fluid such as oil and to alter the characteristics of gases by diffusion, reducing pressures and controlling flow rates. It is manufactured from powered metal, subjected to a series of processing operations.

Details on the material as given in the announcement are:

"Applications for Porex are found in almost any appliance or piece of industrial equipment involving the flow of gases or liquids. These uses are found in pumps, refrigerators, fuel lines, lubricating systems, oil burners, evaporators,

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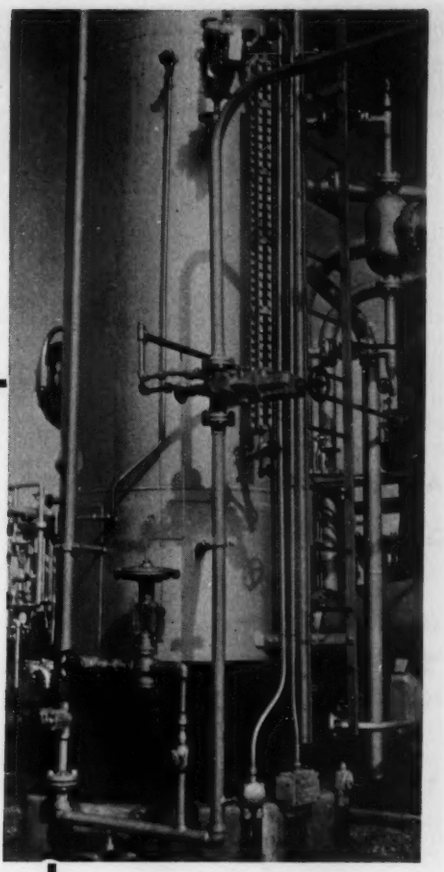

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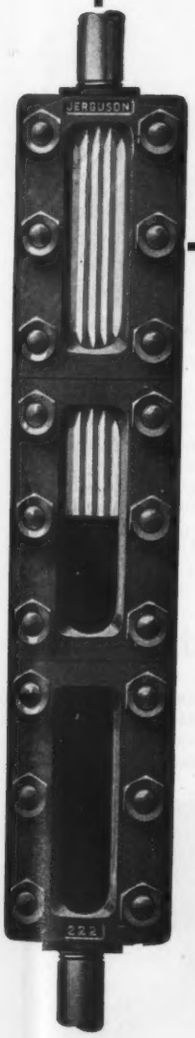

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"This new filter and diffusing material is used to prevent clogging of orifices in Diesel injector nozzles with effective removal of fibrous materials not stopped by other types of filters. It acts effectively in preventing a drying agent from passing from its chamber into a refrigeration system.

"Among the advantages of Porex are its physical characteristics, such as chemical composition, structure, porosity, strength and ductility, which may be varied within certain limits to suit specific applications. Similar variations may be accomplished in its size and shape. Standard shapes now available are discs, sheets, cylinders and truncated cones, while special shapes also are obtainable."

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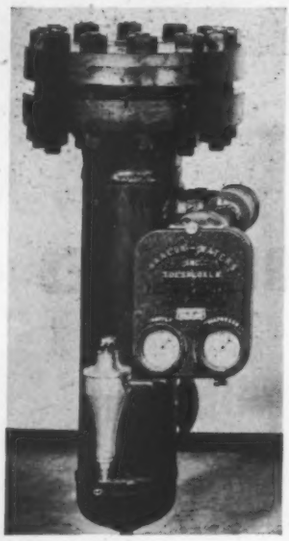
LEVEL CONTROLLER



★ THE ONLY LEVEL CONTROLLER WITH NO STUFFING BOX . . . . LEAKAGE . . . . . FRICTION

H-W TYPE 850 IS SATISFACTORILY HANDLING PROBLEMS THAT WERE CONSIDERED IMPOSSIBLE

ASK THE MEN WHO OPERATE THEM

Complete information and prices available at your nearest HANLON-WATERS Branch.

HANLON-WATERS, INC.

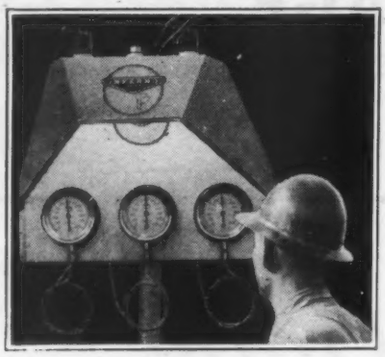
TULSA, OKLAHOMA

New York, Chicago, Pittsburgh, Philadelphia, St. Louis, Denver; Shreveport and Lafayette, La.; Fort Worth, Houston, Corpus Christi, Longview and Odessa, Texas.

Illuminated Gauge Stand

THE INFERNO COMPANY

The Inferno Company, Shreveport, Louisiana, has announced an illuminated gauge stand on which all boiler gauges may be placed together, for visibility and accurate comparison. It is claimed



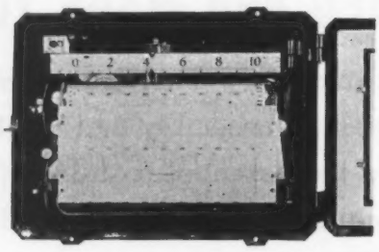
Inferno Gauge Stand

the gauges so mounted are more accurate, being away from the excessive heat of the top of the boiler. The stand is illuminated to increase visibility at night or on murky days, and it protects the gauges from all weather. Smaller, less expensive, gauges may be used and no "gauge savers" are necessary, as the copper tubing from the boiler acts as a perfect condenser. In cold climates the copper tubing may be filled with weight indicator fluid, glycerin, or alcohol, without impairing the accuracy of the gauge.

Proportioning Controller

C. J. TAGLIABUE MANUFACTURING COMPANY

C. J. Tagliabue Manufacturing Company, Park and Nostrand Avenues, Brooklyn, has developed a new proportional controller in which throttling control with or without automatic reset is required. The new instrument employs only a control instrument and a valve mechanism, eliminating the relay detactor.



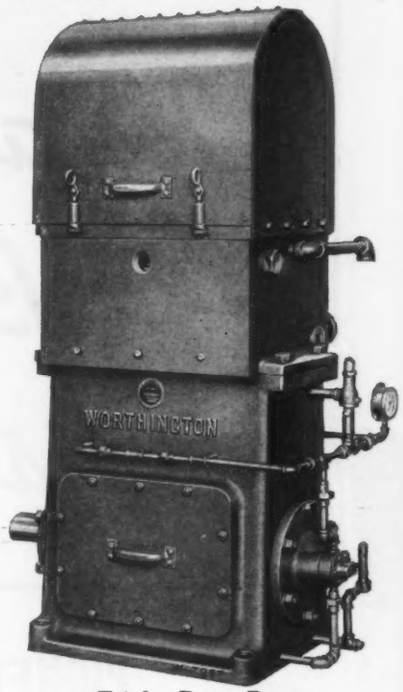
Proportioning Controller

The simple method for throttling control accomplished by this instrument may be briefly described as follows: when the temperature is far below the control point as in starting up, the valve will be wide open; as the temperature rises and enters the throttling zone, the valve will close a relay. This action prevents overshotting as the temperature approaches a balance between heat input and heat loss. The throttling zone can be readily adjusted within wide limits according to the lag characteristics of the application and the maximum permissible sensitivity, easily determined in order that the load error be kept within a few degrees on those models without reset. Other types with adjustment for manual reset (load error) or automatic reset are available.

Triplex Power Pump

WORTHINGTON PUMP AND MACHINERY CORPORATION

Worthington Pump & Machinery Corporation, Harrison, New Jersey, has introduced a high-pressure vertical triplex power pump for pressures up to 9800 pounds and capacities up to 51 gallons per minute. The pump is particularly suited to applications where small capacities and high pressures are required such as special process work in refining.



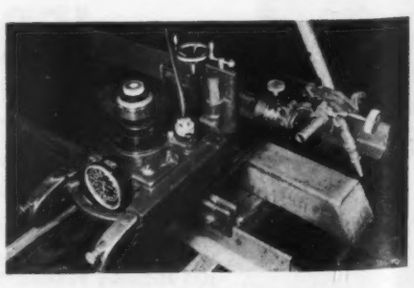
Triplex Power Pump

The pump has no gears and is especially designed for use with built-in gear head motors, although it can be arranged for V-belt drive. One of its features is that its plungers are outboard and there is a dry joint between the liquid cylinder and power frame, to eliminate leakage of the liquid being pumped into the crankcase.

Torch Holder

AIR REDUCTION SALES COMPANY

Air Reduction Sales Company, New York, has just introduced the new Protractor Type Torch Holder, designed for extra convenience and accuracy in Radiagraph cutting torches for any de-



Air Reduction Torch Holder

Pure Transportation Company *selected* DARLING VALVES *for this Model Pipe Line Station*

Interior of a Pure Transportation station handling oil from the Van Field to Pure Oil Co.'s Smiths-Bluff refinery. Equipment includes Darling No. 162, 800 lb. W.P., OS & Y Gate Valves. All valves in interior of building enclosed.

Type of valve used by Pure Transportation Co.

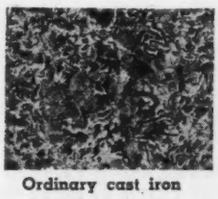
Here's an application where only the best would do. And in valves, that meant Darlings!

Pure Transportation wanted valves with easy operation . . . tight, leak-proof seating . . . and long life. In other words, valves that could be "installed and forgotten." They chose Darlings . . . and got what they wanted.

Here's Why
DARLING DENSE METAL
assures such excellent service

Photomicrograph at left below (Mag. 100X) shows structure of a typical sample of cast iron as ordinarily produced. Note the entrained inclusions tending to break down the strength of the metal and produce leaks.

Photomicrograph at right shows structure of Darling Dense Metal gray iron. In this dense, fine, homogeneous grain structure, the shrinkage porosity has been minimized, with resultant pressure tightness, strength and better resistance to abrasion and corrosion.



Ordinary cast iron

DARLING dense metal

DARLING VALVE & MANUFACTURING COMPANY
Williamsport, Pa.

Representatives in: New York Philadelphia Houston Toledo Pittsburgh Huntington, W. Va. McPherson, Kan.

DARLING
DENSE-METAL
GATE VALVES

sired angle of cut. A bevel cut billet is shown in photograph, an example of the type work for which the accuracy and time-saving features of new holder are said to be particularly valuable. A circular knurled knob permits angular adjustment, shown on scale. Holder has a 90-degree range and can be attached to any standard Airco Radiagraph.

Gauge Insert

YARNALL-WARING COMPANY

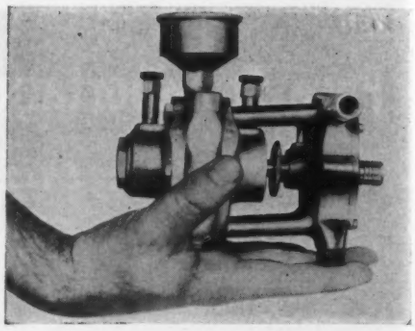
Yarnell-Waring Company, Chestnut Hill, Philadelphia, has perfected an improved pressure sealed flat-glass insert for boiler-water-level gauges. It is built for pressures up to 1500 pounds and has pressure sealed gaskets on the inside faces of glasses and special spring-loaded cap screws for holding down front and back cover plates.

Air Powered Pump

EASTERN ENGINEERING COMPANY

Addition of a new model to its line of midget size pumps has been announced by Eastern Engineering Company, New Haven, Conn. Designated as Eastern Model "D" Air Powered Pump its main features are: air powered motor makes it explosion proof; variable performance (controlled by varying speed of air motor); performance characteristics in relation to size.

Pump may be used in all industrial, pilot plants, laboratory and experimental applications where explosion proof unit is necessary and where compressed air is available. Its size is 5½ x 6 x 7 inches and weighs 10 pounds. Motor is ¼-horsepower, ball bearing air motor (vane type).



Eastern Pump

Units are available in stainless steel, monel metal, chromium-plated bronze, brass, cast iron, and other alloys.

Fluorophotometer

PFALTZ & BAUER, INC.

Pfaltz & Bauer, Inc., Empire State Building, New York, has announced a new fluorophotometer for the visual examination by ultra violet light source of the fluorescence in crude-oil samples for determination of petroleum fractions. The manufacturer lists these possibilities with its use:

With this instrument it is possible to record minute traces of fluorescence in a liquid or solution from a reading instrument. The fluorescence is picked up by a photoelectric cell, converted into electrical energy causing a deflection on the scale of the galvanometer.

Automatic Temperature Indicator

LEEDS & NORTHRUP COMPANY

Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, announces new automatic temperature indicator, designed for use where a large number of thermocouple temperature readings are to be taken.

Leeds & Northrup Temperature Recorder

As many as 50 couples can be used with one instrument. All are individually connected to toggle-switches on the indicator front. To read a couple's temperature, operator simply throws switch and pointer moves automatically to correct scale position.

The instrument automatically performs its operations, leaving operator's hand free to make notations.

"TIME IS SHORT"

In thousands of plants throughout the country posters bearing the above admonition are prominently displayed at the request of the Federal Government. When time is so precious, every minute of down-time means dollars—perhaps human lives.

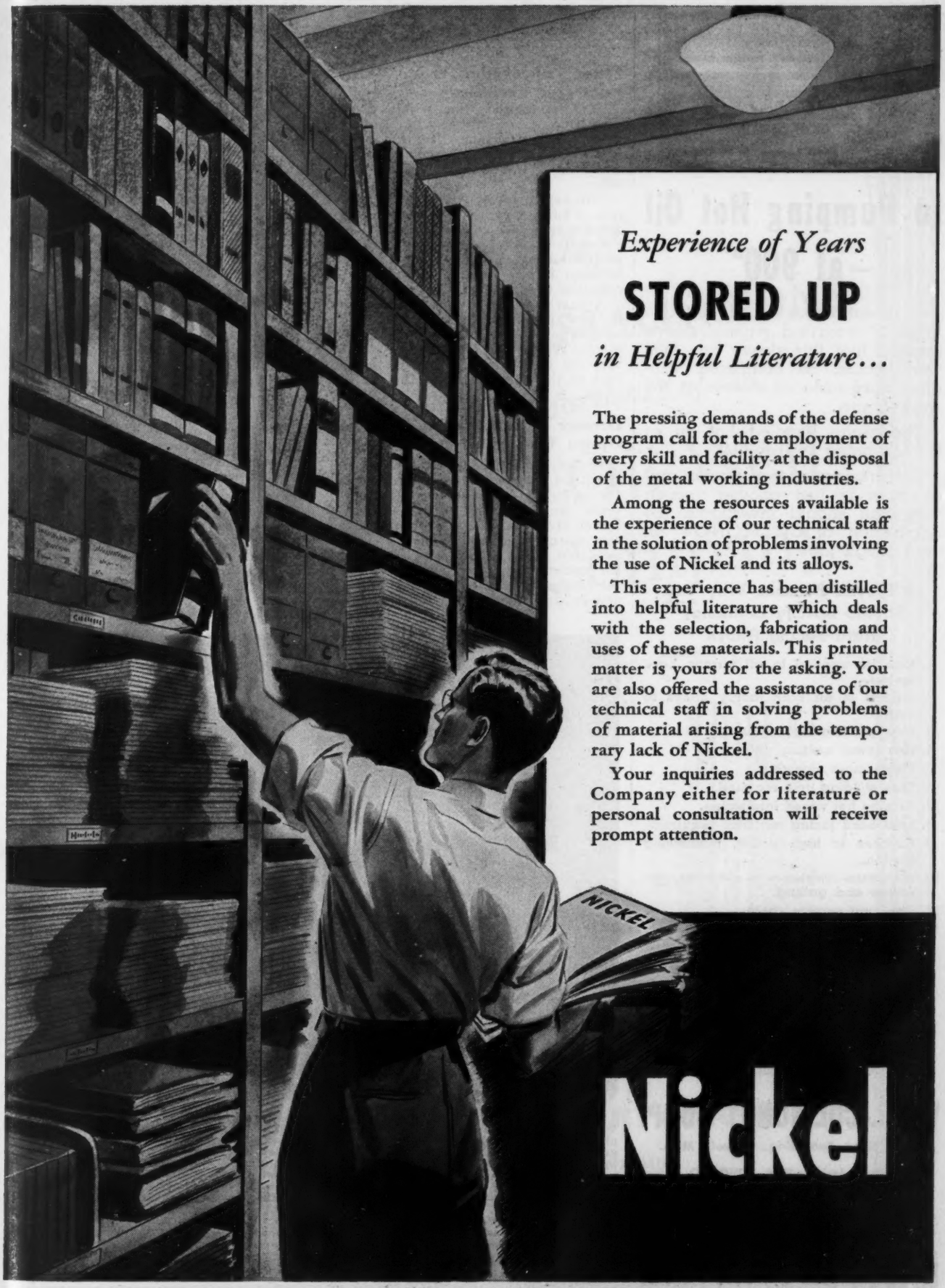
Wilson E P (Extra Power) Tube Cleaners have *extra power, extra strength,* and *extra efficiency.* This enables them to clean tubes in *less time* and at a *lower cost* than ordinary tube cleaners of the same size and thus *reduce* down-time and *increase* production and profits. They deliver from 30% to 75% *more power* but use from 24% to 40% *less air* and save time and money.

There is a Wilson Tube Cleaner and accessory to overcome any coke, scale, or gummy deposit which accumulates in any refinery tube or pipe. Write for the name of our representative nearest to you or send for a copy of our thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.

PIPE AND TUBE CLEANERS EXCLUSIVELY

47-28 37th Street, Long Island City, N. Y.



Experience of Years

STORED UP

in Helpful Literature...

The pressing demands of the defense program call for the employment of every skill and facility at the disposal of the metal working industries.

Among the resources available is the experience of our technical staff in the solution of problems involving the use of Nickel and its alloys.

This experience has been distilled into helpful literature which deals with the selection, fabrication and uses of these materials. This printed matter is yours for the asking. You are also offered the assistance of our technical staff in solving problems of material arising from the temporary lack of Nickel.

Your inquiries addressed to the Company either for literature or personal consultation will receive prompt attention.

Nickel

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

In Pumping Hot Oil —at 900°

—a recent check-up of a COLMONOY coated pump sleeve showed that this sleeve ran 2400 work hours, as compared with other hard-surfaced sleeves at 360 work hours.

The pump handled hot oil at 900°, running 3600 R.P.M.

Such resistance to corrosion and abrasion is just another reason why you should investigate the application of COLMONOY on your tough jobs.

12 Proven Reasons Why You Should Specify Colmonoy Hard Facing Alloys

1. Can be applied to all ferrous base metals.
2. Easiest of all hard facing alloys to apply.
3. Less pre-heating required.
4. Has lower melting point.
5. Flows more smoothly.
6. Less welding time required.
7. Can be hot wiped into shape.
8. Less hard facing material required.
9. Finishes to high polish, minimizing friction.
10. Maximum resistance to abrasion, corrosion and galling.
11. Does not service check.
12. Gives longer life.

Write for Catalog

Our engineers will be glad to discuss the proper application of COLMONOY to meet your individual requirements. Your letter will receive prompt attention.

WALL-COLMONOY CORP.

Sixth Floor, Buhl Bldg., Detroit, Mich.

625 W. Jackson Blvd., CHICAGO
123 W. Philadelphia St., WHITTIER, CALIF.
558 W. 54th St., NEW YORK
208 Midco Building, TULSA
21 Seneca St., BLASDELL, N. Y.

COLMONOY
Hard Surfacing Alloys and Overlay Metals

BUSINESS NOTES

Fluor Corporation Is Enlarging Facilities

For the second time within a year The Fluor Corporation, Ltd., Los Angeles is enlarging plant facilities. Along with additional plant space the current work involves additional space for the office.

The new plant space is 10,000 square feet of space which will house a mill for aerator type atmospheric and mechanical draft cooling towers. The addition of 1600 square feet of office space will be used for the cooling tower and accounting departments.

A year ago the company moved into its new plant, which was designed to add 50 percent expansion for all departments. Within two months it was necessary to enlarge office space to take care of the demands upon the drafting room.

Dresser Manufacturing Company Opens Warehouse at Houston

Dresser Manufacturing Company, Bradford, Pennsylvania, has announced the opening of a new warehouse to serve the Southwest at 1121 Rothwell Street, Houston. The announcement said the warehouse was opened to make available ready-made joints overnight for speedy laying of pipe lines since the national emergency calls for speed in new drilling and construction of oil lines.

David H. Geiser is in charge of the Southwest warehouse. C. T. Davis, district manager, gas and water division, and H. R. Shidel, district manager, oil field division, will have their headquarters in the new district office.

Foxboro Company Moves Cincinnati Office

The Foxboro Company, Foxboro, Massachusetts, has moved its office to 607 American b ilding, Walnut Street and Central Parkway.

Merco Nordstrom Has New Los Angeles Quarters

Merco Nordstrom Valve Company and Pittsburgh Equitable Meter Company have moved to new quarters in Los Angeles, 3136 East Eleventh Street. It represents the fifth expansion of facilities on the West Coast.

The new location occupies approximately 25,000 square feet of space. A modern, streamlined building has been erected with spur track for shipments from the factories direct to the warehouse.

An air-conditioned, temperature-controlled proving department has been included to scientifically and accurately check gas meters. Modern facilities are installed for repairing valves, water meters, orifice meters and oil and gaso-

Workings of the expansion roof of an 80,000 barrel gasoline storage tank at the East Chicago plant of Socony-Vacuum Oil Company have been observed by groups of refining engineers. The groups entered the tank, whose roof then was operated by compressed air. The tank was built by Graver Tank & Manufacturing Company, East Chicago.

Those in the group above are: 1, Edward Hoffman, construction engineer, Socony-Vacuum Oil Company; 2, F. C. Kardevan, Graver Weldery Division sales; 3, Frank Long, president, Vapor Recovery Systems; 4, G. L. Johnson, eastern sales manager, Graver Tank & Manufacturing Company; 5, E. C. Rowe, chief engineer, The Texas Company, Lockport, Illinois; 6, C. A. Ellis; 7, Kenneth Roberts, engineer, Socony-Vacuum Oil Company; 8, T. O. Larsen, engineer, Graver Tank & Engineering Company; 9, Charles Bunn, Standard Oil Development Company; 10, P. O. Harrington, Standard Oil Development Company; 11, A. G. Love, Texas-Empire Pipe Line Company; Frank Halloway, Vapor Recovery Systems; 13, R. P. Lepley, assistant chief engineer, Atlantic Refining Company; 14, J. B. Wolston, manager of terminals, California-Texas Company; 15. Phil S. Graver, vice president, Graver Tank & Manufacturing Company; 16, Charles Miller, chief engineer, Shell Oil Company; 17, C. L. Marner, Graver Conservation Equipment sales; 18, L. A. Wilkin, manager, Graver Development division; 19, Kenneth Miller, Shell Oil Company; 20, Clarence Prescott, assistant chief engineer, Shell Oil Company; 21, Harvey Blankenship, advertising manager, Graver Tank & Manufacturing Company.

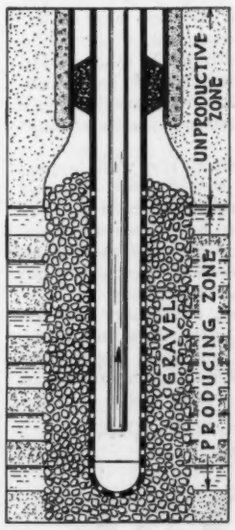
Announcing

GRAVEL PACKING* INSTALLATIONS

through the nation-wide facilities of the

Halliburton Oil Well Cementing Company

*Gravel Packing by Circulation



THE Halliburton Oil Well Cementing Company's nation-wide organization now stands ready to supply complete installations of Gravel Packing by Circulation to producers experiencing difficulties with sand infiltration.

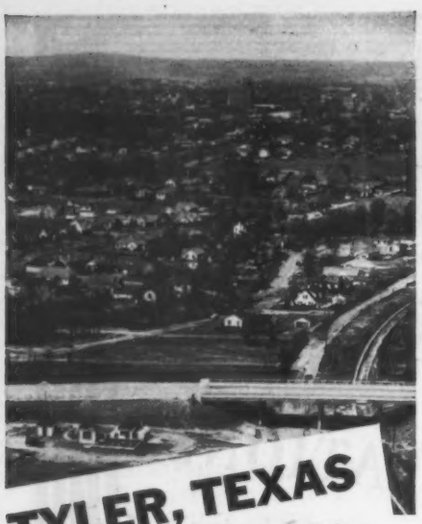
This method of sand control has now fully demonstrated its effectiveness . . . its ready adaptability to varying sand conditions . . . its simplicity and low cost.

With the trained personnel and modern equipment of the Halliburton organization readily available in all producing fields, the easy availability of Gravel Packing under this new arrangement should go far toward making it the standard procedure of the industry in combating sand.

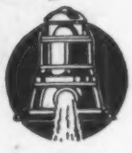
TEXACO DEVELOPMENT CORPORATION

A Subsidiary of The Texas Corporation

26 Journal Square • Jersey City, N. J.



TYLER, TEXAS
City and Industry—
100% Layne



NUMEROUS are the cities and towns where municipal and industrial water wells and pumps are 100% Layne. The progressive and thriving city of Tyler, Texas, is an example. The first ground water development in that area was installed by Layne in 1934. Since then all municipal and industrial well water supply and turbine pump systems have been Layne.

In meeting defense and armament project emergencies, Layne Companies have broken all records, both in the number of wells and pumps installed and in the quantity of water produced, in any like period of time. In addition to such added activity, Layne Companies have continued their service to municipal and industrial non-defense projects without appreciable delay.

Layne is unquestionably the largest and most widely experienced ground water developing organization in the Nation. Their methods have proven most successful and the number of their completed projects exceeds that of any other organization ten times and more.

Layne has the men, machinery and experience necessary to handle water development contracts of any size. Their Engineers are ready to cooperate on your plans. If you need more water, write or wire.

LAYNE & BOWLER, INC.
Memphis, Tenn.

LAYNE
PUMPS & WELL WATER SYSTEMS

AFFILIATED COMPANIES

Layne-Arkansas Co.	Stuttgart, Ark.
Layne-Atlantic Co.	Norfolk, Va.
Layne-Bowler New England Corp.	Boston, Mass.
Layne-Central Co.	Memphis, Tenn.
Layne-Northern Co.	Mishawaka, Ind.
Layne-Louisiana Co.	Lake Charles, La.
Layne-New York Co.	New York City.
Layne-Northwest Co.	Milwaukee, Wis.
Layne-Ohio Co.	Columbus, Ohio.
Layne-Texas Co.	Houston, Texas.
Layne-Western Co.	Kansas City, Mo.
Layne-Western Co. of Minnesota	Minneapolis, Minn.
International Water Supply	London, Ontario, Can.

line meters. Complete facilities have been established for giving factory service.

Two New Members for Supply Association

Two new members have been added to the Natural Gasoline Supply Men's Association, D. W. Haering Company, Chicago; and W. H. Curtin Company, Houston.

The organization functions in cooperation with the Natural Gasoline Association of America. Entertainment is provided for the annual meetings. The supply group also prints the Technical Manual, which is revised frequently and distributed to personnel of the natural gasoline and refining industries.

Association Reprints Gasoline Manual

A second printing, 1000 copies, of the Technical Manual, fourth edition, has been made by the Natural Gasoline Supply Men's Association. Only 300 copies of this second edition remain at headquarters, 923 Kennedy Building, Tulsa. The first printing was 3000 copies and the supply was exhausted shortly after distribution started in April, 1941.

Bastian-Blessing Moves To Larger Building

Bastian-Blessing Company, manufacturers of high pressure gas equipment and oxy-acetylene welding and cutting apparatus has moved to its new office and factory, 4201 Peterson Avenue Chicago. The new building and equipment double the capacity of the former plant.

The building covers 182,000 square feet on a single floor and has departments so arranged that materials and operations flow without interruption from one end to the other. The site covers 13 acres.

Oscar E. Hesse has been appointed secretary-treasurer of the Logan Engineering Company, Lawrence and Lamon avenues, Chicago. The concern is a manufacturer of aridifiers for removing moisture and dirt from compressed air and gas lines, as well as a maker of lathes and mine hoist controllers and recorders.

Edgar F. Heckert has been appointed special assistant to the general works manager of York Ice Machinery Corporation, York, Pennsylvania. In this position he will make studies in the manufacturing division designed to increase efficiency and production. Previously he was manager of the service department.

F. L. Swindell

Floyd L. Swindell has been appointed Mid-Continent sales representative for Vapor Recovery Systems, Compton, California. He will make headquarters in Tulsa.

Swindell is a graduate of the University of Oklahoma with post graduate work at George Washington University. After graduation from the University of Oklahoma he joined the staff

MONEY SAVING *News* FOR REFINERIES AND PRODUCERS

LOW-COST WAY TO CLEAN TANK CAR INTERIORS

Due to the increasing number of tank cars now being used for transporting petroleum products, these units must be prepared for this service with minimum time and effort.

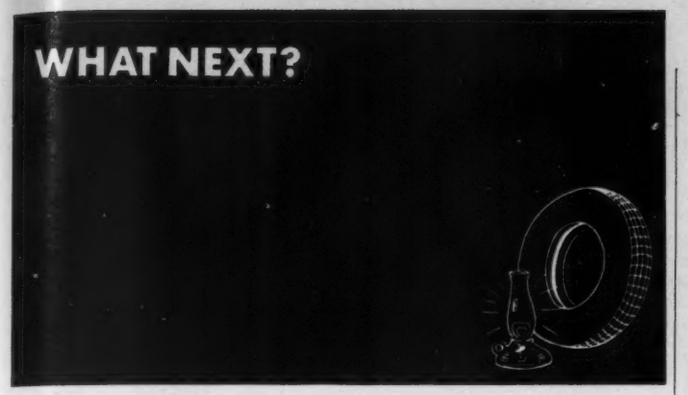
Do this work the FAST, EASY Oakite way by using the Oakite Interior Tank Cleaning Unit, Model No. 324. Does the job in HALF the time previously required by manual methods . . . at a 40% SAVING in cost. And it is SAFE . . . no fire hazards, no obnoxious fumes!

Save Time . . . Money ON THESE JOBS, TOO!

Now, when equipment is operating at full capacity, Oakite materials and methods can help you SPEED-UP work on such other maintenance jobs as safely de-scaling Diesel water jackets, cleaning heat exchangers, steam cleaning trucks and tractors, washing drums. Write for details.

OAKITE PRODUCTS, INC.
50B Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada

OAKITE *Certified* CLEANING



It's a far cry from lamp fuel to rubber substitutes, but the amazing development in the manufacture of petroleum products has been made possible largely by progress in chemistry, and

HOOKER
CHEMICALS

have contributed their share. Among the HOOKER products used in the manufacture of petroleum products are HOOKER Caustic Soda, Aluminum Chloride, Cyclohexanol, and many others. HOOKER chemists and engineers are always ready to co-operate on any problem involving the choice or use of chemicals.

HOOKER ELECTROCHEMICAL COMPANY
NIAGARA FALLS, NEW YORK
NEW YORK CITY TACOMA, WASHINGTON

486

... More heat because the thermostatic type of trap extracts the last b.t.u. possible before the condensate is discharged.

More speed because the Sarco No. 9 vents air rapidly. "Gangway for live steam" is its motto.

WITH
SARCO No. 9
THERMOSTATIC
STEAM TRAPS

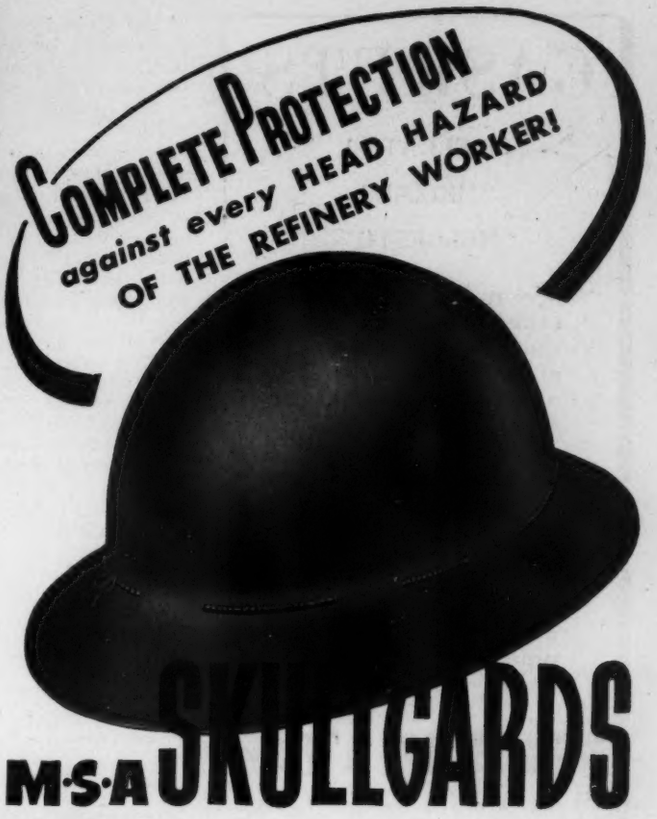
Made for pressures up to 250 lbs., it requires no adjustment or seat change when pressures change.

Consult the Sarco representative near you. His years of experience and the complete Sarco line of traps enable him to give impartial advice. Ask for Cat. No. 250.

122

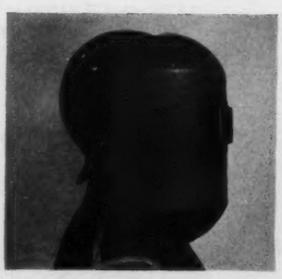
SARCO
SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
SARCO CANADA LTD., TORONTO, ONT.



M·S·A SKULLGARDS

These standard work hats dependably provide *time-proved head protection and comfort* for refinery and oilfield workers everywhere. Made of laminated bakelite, Skullgards offer high impact resistance to blows from falling or flying objects, are impervious to the effects of oil, water, heat, perspiration and ordinary chemicals; are non-softening and non-conductive to electricity. Furnished with rubber-cushioned sweatband and shock-absorbing hammock in crown, Skullgards are self-ventilated and "easy on the head as an old felt hat." May be equipped with earlugs for cold weather comfort. Write for descriptive Bulletin No. DK-6.



M·S·A Combination
SKULLGARD-WELDING SHIELD

Combining head and eye safety for welders, this practical combination includes the sturdy head protection of a cap-type Skullgard with a tilting welding shield of superior design. The Skullgard may be detached from the shield and worn separately wherever desired. Write for Bulletin No. CE-9.

Demonstrations will be gladly arranged on request

MINE SAFETY APPLIANCES COMPANY
BRADDOCK, THOMAS AND MEADE STREETS · PITTSBURGH, PA.
District Representatives in Principal Cities

GASKETS

"MELRATH"

"MELOIL"

"MELBESTO"

- **We make gaskets in steel, copper, lead, monel metal stainless steel, Armco iron, aluminum, nickel, fibre, rawhide, rubber or any other material. Plain, corrugated or perforated metal. Metal - asbestos and other combinations; to suit any use—for gasoline, acids, oil, chemicals, alcohol, steam, ammonia, etc. Any size, shape, quantity.**

MELRATH

SUPPLY & GASKET CO., INC.

Tioga & Memphis Sts., Phila., Pa. Est. 1909

CATALYSIS

Inorganic and Organic

By SOPHIA BERKMAN, JACQUE C. MORRELL and GUSTAV EGLOFF
(Research Laboratories, Universal Oil Products Company)

Catalysis, including inorganic and organic reactions in both pure and applied science, has been studied with steadily augmenting intensity for more than one hundred years. In many varied fields of science and industry, Catalysis has come to occupy a revolutionizing position, a fact clearly emphasizing the importance of a thorough knowledge of the subject.

CONTENTS

The Phenomenon of Catalysis
Adsorption and Catalysis
Heterogeneous and Homogenous Catalysis
The Activity of the Catalyst
Inhibitors in Catalysis
Promoters and Poisons in Catalysis
Carriers in Heterogeneous Catalysis
Catalytic Reactions in Inorganic and Organic Chemistry
Physical Conditions in Catalytic Reactions
Classification of Catalysts with Respect to Type of Reaction
Catalysis in the Petroleum Industry

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The GULF PUBLISHING COMPANY

P. O. Drawer 2608 Houston, Texas

of the United States Bureau of Mines, as assistant petroleum engineer at the Bartlesville station. Then he was with the United States Treasury Department in the income tax unit as a valuation engineer.

From 1930 to 1936 he was on the staff of THE OIL WEEKLY, as editorial representative in Kansas and Oklahoma with headquarters at Tulsa. Since 1936 he has been doing consultation work in geology and engineering and has been with both Texas Steel Company and Buda Engine and Sales Service.

Wallace W. Lockwood has been appointed advertising manager of the Taylor Instrument Companies, Syracuse, New York. He has been in the Taylor advertising department since 1932 and has been assistant manager since 1939. He succeeds Elmer E. Way, who resigned.

He is a graduate of Auburn high school and of Syracuse University. Previous to his connection with the Taylor companies he had experience in three advertising agencies.

H. B. Bristol has been transferred from the Chicago office to the Boston office of the Bristol Company, 250 Stuart Street. J. E. Booth has taken over the territory in the Chicago district formerly covered by Bristol.

Gordon LeFebvre

Gordon LeFebvre has been elected vice president and general manager of Cooper - Bessemer Corporation. His selection fills a vacancy occasioned by the death of Charles B. Jahnke. B. B. Williams, who returned to active duty following the death of Jahnke, will remain president and chairman of the board.

LeFebvre came to his new position from American Locomotive Company, where he was manager of the Diesel division. After his schooling, which included attendance at the United States Military Academy, he was with the Northwestern Railroay Company and with E. I. duPont de Nemours & Company, where he became general superintendent. In 1919 he joined General Motors Corporation and came to be vice president of all the activities in Canada. He later returned to become vice president of the Pontiac division. From 1932 to 1936 he was a consulting engineer in Detroit and in 1937 joined American Locomotive Company.

C. T. Hapgood has been appointed assistant district sales manager at Houston for Jones & Laughlin Steel Corporation, the company has announced. He formerly held the same position in Los Angeles. At the same time the company announced that W. R. K. Scott was transferred from the Jones & Laughlin Houston office to the Los Angeles office.

C. T. Hapgood

Jack W. Green has been appointed manager of the Chicago territory for Tube-Turns, Inc., Louisville, manufacturer of welding fittings.

He has had experience with the company in both the headquarters office and in Chicago.

Previously he was with American Radiator and Standard Sanitary Corporation as manager of the Akron branch.

J. W. Green

Clarence H. Kennedy, vice president in charge of sales of the Kennedy Valve Manufacturing Company, died recently in Elmira, New York after an extended illness. He was a graduate of Cornell University in 1912 and spent his business career with the concern, which was founded by his father, Daniel Kennedy, in 1877.

Gordon T. Lepley has been appointed district representative for Darling Valve and Manufacturing Company in Texas. He succeeds F. C. Cavenaugh, who resigned recently after 20 years with the company.

WANTED—Refinery Safety Engineer. Position includes responsibility for pressure still inspections, general safety work, and fire protection equipment. Some operating or engineering experience preferred. Box 53A, c/o The Refiner, Houston, Texas.

WANTED: Young graduate engineer as assistant to refinery engineer. Two to four years refining experience including drafting, refinery construction and maintenance. Location, southwest. Submit complete details of qualifications, salary desired, photograph, etc. Address Box 219, The Refiner, Houston, Texas.

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